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Full Name of Author — Nom complet de l'auteur

DAVID JAMES MAGEE

Date of Birth — Date de naissance	Country of Birth — Lieu de naissance
APRIL 1, 1944	CANADA

Permanent Address — Résidence fixe

3242-109A ST
EDMONTON, ALTA

Title of Thesis — Titre de la thèse

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1980	DR. S.W. MENDRYK

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THE EFFECT OF ISOKINETIC EXERCISE ON HUMAN HEART RATE AND BLOOD PRESSURE

by

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A Thesis

Submitted to the Faculty of Graduate Studies and Research

in Partial Fulfillment of the Requirements for the Degree

of Doctor of Philosophy

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THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled The Effect of Isokinetic Exercise on Human Heart Rate and Blood Pressure submitted by David J. Magee in partial fulfilment of the requirements for the degree of Doctor of Philosophy in Sport Sciences.

S. W. Mensbrugh
Supervisor

External Examiner

Date October 7, 1980

Dedication

To Wendy and Shawn

ABSTRACT

The purpose of the study was to determine the effect of isokinetic exercise on heart rate and blood pressure at three different speeds of movement and to determine if an isokinetic interval program had a cumulative effect on heart rate and blood pressure. In addition, the quadriceps and hamstring muscle groups were tested isometrically on the Cybex II isokinetic apparatus. The effects of isometric exercise on heart rate and blood pressure were observed and compared with the results found in previous studies.

The data was analyzed using a one-way, two-way, and three-way analysis of variance on repeated measures, and Tukey and Scheffe Tests. Within the confines of the study, the null hypothesis was rejected at the .001 level of confidence for isokinetic exercise at all three speeds used - thirty degrees per second, ninety degrees per second, and 150 degrees per second.

The data showed that heart rate increased with both isometric and isokinetic exercise and the increase was larger for isokinetic exercise. Systolic and diastolic blood pressure rose with isometric exercise while systolic blood pressure rose and diastolic blood

pressure fell with isokinetic exercise. The increase in systolic blood pressure was greater with isokinetic exercise than with isometric exercise.

Modified tension time index, and pulse pressure were higher during isokinetic exercise than during isometric exercise. Mean blood pressure was higher during isometric exercise.

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CHAPTER I

INTRODUCTION

Traditionally, isometric and isotonic type of exercises have been used by individuals to improve muscle power and strength. In 1967 a new form of exercise was developed by J.J. Perrine and his associates. This new form of exercise was called isokinetic exercise. This original system, called the Cybex exerciser, was the first of several similar systems which used the principle of accommodating resistance (1).

Using the principle of accommodating resistance, isokinetic offers maximum resistance through a full range of motion. Isometric exercise offers maximum resistance but only at selected points in the range of motion as no movement occurs during this type of exercise. Isotonic exercise, on the other hand, allows full range of motion but gives maximum resistance only in the weakest parts of the range of motion (2,3,4). To offer accommodating resistance, the Cybex apparatus uses an electromechanical braking mechanism. Other isokinetic devices use hydraulic

braking mechanisms (Orthotron) and a centrifugal brake arrangement (Mini-Gym).

Isokinetic exercise machines control the speed at which a joint moves through the range of motion. Some of these machines have only one speed, while others have a variable speed. The speed can be varied from zero degrees per second to 300 degrees per second depending on the device utilized.

With isokinetic exercise the muscle force transmitting capacity is accommodated through the full range of motion. The electromechanical braking mechanism of the Cybex exerciser, which is used in this study, acts as a governor to control the speed of the lever arm of the dynamometer. In so doing, the mechanism fluctuates with the changes in muscle tension and the skeletal leverage advantage by varying the load accordingly. The force of the muscles against the lever arm results in a resistance load on the lever arm which is the result of mechanical energy absorption. Thus, maximum resistance is offered only if maximum muscular tension is developed by the subject.

By watching the recorder showing the torque output on the Cybex machine, one is able to tell if the subject is exerting maximum effort. If the subject is exerting maximum effort, the torque curves will show an orderly

decreasing progression in peak torque height. If the subject is not exerting maximum effort, the torque curves will show a more erratic tracing of peak torque heights (see Figure 1).

The Cybex II apparatus has several advantages. It is one of the few devices which can load a muscle maximally and still allow the limb to move through a full range of motion. In so doing, it works both the agonist and antagonist muscles around the joint. It provides a visual feedback system in the form of a dial on the dynamometer and a graphic recorder. Finally, it adjusts for pain and fatigue by its mechanism of accommodating resistance and by so doing prevents the joint being exercised from being overstressed.

Purpose of the Study

In reviewing the articles concerned with isokinetic exercise (2,3,5,6,7,8,10,11), there is a body of knowledge being developed as to the effect of isokinetic exercise on strength, power and endurance. Throughout the literature however, this is only one mention of the effect of isokinetic exercise on heart rate and blood pressure. David R. Lamb (12) in his book "Physiology of Exercise" has indicated that isokinetic exercise

(a) Peak Torque Heights with Maximum Effort

(b) Peak Torque Heights with Submaximal Effort

Figure 1: Peak Torque Heights with Maximal and Submaximal Effort

offered "some cardiac risk as opposed to isotonic exercise offering a 'slight' risk and isometric exercise offering a 'moderate' risk". When presenting this table, Lamb offered no references to support this obervation. There have been several articles concerned with the effect of isometric and/or isotonic exercise on heart rate and blood pressure (13,14,15,16,17,18,19,20,21,22, 23,24,25,26,27,28,29,30). As isokinetic exercise, in causing maximum contraction through a full range of motion of one group of muscles, causes maximum relaxation in the reciprocal muscles, the effect on heart rate and blood pressure may be different from isometric or isotonic exercise.

A review of the literature revealed that no standard rate of speed was used by authors in isokinetic exercise programs. The authors often differentiating their programs only into fast and slow speeds (2,5,6, 7,8,9,10,11,31,32).

Thus, the purpose of this study is two-fold:

(a) to determine the effect of isokinetic exercise on heart rate and blood pressure at three different speeds of movement, and;

(b) to determine if an isokinetic interval program has

a cumulative effect on heart rate and blood pressure.

Delimitations

1. This study is limited to three speeds on the isokinetic apparatus (30 degrees per second; 90 degrees per second, and; 150 degrees per second).
2. The study is limited to exercising one set of reciprocal muscle groups (quadriceps-hamstrings) in the lower limb.
3. The study is limited to twenty-four (24) caucasian male subjects with no known cardiovascular problems (14).
4. The study is limited to subjects between the ages of 20 years and 35 years (33,34,35,36).
5. The study is performed on a Cybex II isokinetic apparatus manufactured by Lumex Corporation, Bay Shore, New York.
6. The examiner will verbally motivate the subjects if it appears from the tape readout on the isokinetic recorder that they are not exerting maximum effort.
7. Familiarization to the Cybex apparatus and the experimental procedure is limited to one practice session immediately prior to the first test for all subjects.
8. The blood pressure was recorded using a sphygomomanometer and stethoscope (37,38,39,40).

Definition of Terms

1. Diastolic Blood Pressure: pressure in the arteries during diastole or the period of dilatation of the heart. The average ausculatory value is 80-90 mm of mercury (34,36,38).

2. Heart Rate: the number of contractions of the ventricles of the heart per unit time.

3. Isokinetic Exercise: a muscular contraction with a shortening of the muscle length against an electro-mechanical braking system at a controlled speed of movement so that the resistance is accommodating to the maximum muscle force at each point in the range of motion.

4. Isokinetic Endurance: total work done in a specified time period calculated by summing the total peak torques.

5. Isometric Exercise: a muscular contraction with minimal muscle shortening and the joint exhibits no perceivable movement.

6. Korotkoff Sounds: sounds heard or recorded during ausculatory blood pressure determination when the

pressure in a blood pressure cuff is allowed to fall to zero from a pressure which is great enough to occlude circulation.

(a) the first sound heard (a clear tapping or thumping sound) indicates the passage of blood under the cuff and represents the systolic pressure.

(b) the moment the sounds disappear, the blood passes freely through the artery and represents the diastolic pressure. This is sometimes called the second diastolic pressure (34,41).

7. Mean Blood Pressure: the blood pressure calculated by taking two-thirds of the diastolic pressure plus one-third of the systolic pressure (42). It is an indication of the driving force required to drive the blood through the circulatory system.

8. Modified Tension Time Index (MTTI): an indication of the oxygen consumption of the heart (43,44,45,46). It is calculated using the following formula:

$$\text{MTTI} = \frac{\text{Heart Rate} \times \text{Systolic Blood Pressure}}{100}$$

9. Peak Torque: the highest torque reading on the graph during each contraction.

10. Pulse Pressure: the numerical difference between the systolic and diastolic blood pressures.

11. Systolic Blood Pressure: pressure in the arteries during systole or the period of contraction of the heart. The average ausculatory value is 120-130 mm of mercury.

12. Torque: a force perpendicular to a lever arm which is rotating about an axes of rotation.

Basic Assumptions

This study proceeded on the following assumptions:

1. The subjects performed each test working maximally at all times.

2. The exercises performed were sufficiently strenuous to cause an effect on the cardiovascular system.

3. Under the conditions which the study was conducted, the changes which were noted, if any, were the result of the isokinetic exercise.

Hypothesis

The following null hypothesis was investigated:

If isokinetic exercise is performed during an interval program using the quadriceps and hamstring muscle groups on normal male subjects, there will be no significant change in the heart rate or blood pressure of the subjects during the exercise or after the exercise. Three speeds of isokinetic exercise were used (thirty degrees per second, ninety

degrees per second, and 150 degrees per second).

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CHAPTER II

REVIEW OF LITERATURE

The review of literature is organized into four areas. Firstly are the general principles of isokinetic exercise; secondly are the effects of isotonic exercise on heart rate and blood pressure; thirdly are the effects of isometric exercise on heart rate and blood pressure; and finally, is the neurological control of circulation.

General Principles of Isokinetic Exercise

The original isokinetic exerciser was developed by J.J. Perrine and associates in 1967. Isokinetic exercise offers maximum resistance through a full range of motion. This is accomplished by controlling the speed of contraction. Depending on the apparatus used, this speed is either set by the manufacturer or can be adjusted by the operator of the device. This speed control provides voluntary concentric contractions which may be reciprocal depending on the apparatus used (1,2).

Acceleration and thus inertia only occurs until

the predetermined speed of the apparatus is reached. Once the speed is reached, the force applied by the subject is converted to torque rather than acceleration. This torque is proportional to the magnitude of the muscular force and is exhibited on the dial of a dynamometer and on a recorder. It is this value of force output at a slow velocity of the muscle which is often referred to as strength, but in reality is a measurement of power in isokinetic tests (3,4,5,6,7,8).

The torque or strength measure is a product of the force which acts about an axis of rotation times the perpendicular distance from the axis of rotation. The torque value will vary through the range of motion due to the lever system of the human body and neuro-physiological factors. Thus, it is important to consider stabilization of the subject, joint alignment (centre of joint as close as possible to the axes of rotation), and, shaft length of the dynamometer when performing testing on an isokinetic apparatus (6,8,9, 10,11).

Peak torque or the maximum torque reading provides an easy reference when comparing the musculature across two joints. The peak torque is easy to note and when taken over time can provide an average peak torque to

note any improvement. For example, Moffroid et al (8) state that a difference of greater than ten percent when testing the same muscles indicates a strength deficit in the weaker muscle.

In isokinetic terms, torque may also be considered work. Because the lever arm is kept constant for each subject, work, which is ɔrce times distance, is the area under the torque curve. The work accomplished by the subject can be determined by the formula:

$$WORK = T \times 2 \times d,$$

where T is the torque in foot pounds and d is the portion of the arc travelled (1,2,5,8,11,12).

Power as demonstrated on the isokinetic apparatus is a mechanical measurement of work done per unit time. It is determined by the formula:

$$POWER = \frac{\text{Torque} \times 2 \times \text{revolutions per minute}}{\text{time (minutes)}}$$

It is this average power output during a given time frame which constitutes a definition of endurance in isokinetic terms (5,6,8,11,12).

When using isokinetic exercise for research and testing, one must be aware that a definite learning curve is present during the first few sessions. Thus it is important in studies where the torque values are of primary importance that each subject be given

sufficient time to learn how to use the apparatus (7).

Moffroid et al. (8) have shown that using slow speed isokinetic exercise will increase torque values at slow velocities. Fast speed isokinetic exercise will increase torque values at all speed settings up to the fast speed but not to as high a torque value reading as was accomplished at the slow speed. Fast speed isokinetic exercise also increased the endurance of muscles exercised.

Reliability of isokinetic exercise was found to be high in terms of torque, range of motion and speed measurement provided certain conditions were met. A period of warm up and familiarization of the apparatus is required as well as proper stabilization and positioning of the apparatus. As well, the lever arm length must be constant for each subject. Reliability coefficients ranged from 0.93 to 0.99 (13,14,15,16).

Effect of Isotonic Exercise on Heart Rate and Blood Pressure

Tuttle and Horvath (17) found that when their subjects exercise on a bicycle ergometer at a work load of 1250 kilogram -meters for one minute, there was a rise in systolic blood pressure from 125 mm of mercury to 173 mm of mercury while the diastolic pressure remained

virtually the same, fluctuating from 83 mm of mercury to 87 mm of mercury.

Lind and McNicol (18) found that rhythmic exercise caused an increase in heart rate as well as an increase in systolic blood pressure. At the same time, a decrease in the diastolic pressure was found. The authors felt that these effects resulted from a large increase in blood flow through the muscles during the period of intermittant relaxation which had the effect of delaying fatigue.

Kramer (19) found that with treadmill walking by elderly subjects, the heart rate increased gradually with the exercise value after one minute being significantly greater than the resting heart rate value. Kramer also found that the systolic pressure increased with exercise while diastolic pressure remained virtually the same.

Effect of Isometric Exercise on Heart Rate and Blood Pressure

Bartels et al. (20) found that heart rate increased with isometric exercise but did not reach a maximum value until immediately after the cessation of exercise. This was then followed by a drop in heart rate to resting

levels, in some cases, within twenty seconds. At the same time, Bartels and his associates found that systolic blood pressure increased throughout the exercise bout (maximal arm and leg isometric contraction for ten seconds) reaching a maximum value immediately following exercise. In most cases, the systolic pressure returned to resting levels within two and a half minutes. Diastolic changes were found to be small and in most cases return to resting level within two minutes.

Kivowitz et al. (21) found that when subjects were asked to hold a dynamometer at 25% maximum voluntary contraction for five minutes, there was an increase in mean arterial pressure and heart rate. The authors felt this was suggestive of an increase in sympathetic tone predominating over baroreceptor-induced increase in vagal tone.

Lind and McNicol (18) found that heart rate and blood pressure changes were noted even during low contraction tensions such as 15 per cent maximum voluntary contraction. The authors felt that if sustained exercises were performed during rhythmic exercises, the reflex hemodynamic effects of the sustained contractions could be beneficial. Lind and McNicol stated that the

blood flowing through the muscles performing the rhythmic exercise would be enhanced by the increase in perfusion pressure caused by the sustained contraction. The cardiac output during the isometric contractions tended to be higher than during isotonic exercise and the authors felt this would benefit the muscles performing rhythmic exercise.

In another study, Lind and McNicol (22) found that during isometric contraction of 5-10 percent maximum voluntary contraction, the heart rate and blood pressure both increased and reached a steady state when the contraction was held for three minutes. At tensions of 15-20-30 per cent maximum voluntary contraction, again the heart rate and blood pressure increased but a steady state was not reached. Donald et al. (23) reported similar data.

Thompson (24) found that isometric exercise resulted in an increase in both systolic and diastolic blood pressure while isotonic exercise caused an increase in systolic pressure only, while the diastolic pressure remained relatively constant. Thompson also found that the systolic blood pressure returned to near resting levels faster (within one minute) following isometric exercise while the diastolic pressure returned to resting levels within three to four minutes.

Hoel et al. (25) showed similar changes in hypertensive subjects. The hypertensive subjects did show a higher value for systolic and diastolic pressure than did the normotensive subjects, but these subjects also started with higher resting values.

Nagle (26) stated that one of the problems encountered with isometric exercise was that of breath holding or the valsalva manoeuver which is holding the breath and straining against a closed glottis. The valsalva manoeuver causes an acute rapid increase in blood pressure. The high intrathoracic pressure reduces venous return and the arterial pressure falls causing a reflex vasoconstriction of peripheral arterioles. Thus a pressure load can occur to the heart.

Other studies in the literature (27,28,29,30,31,32, 33) have shown similar results. The degree of blood pressure elevation depends on the degree of isometric contraction. As the tension of the isometric contraction increases, the blood pressure elevation is more marked and occurs more rapidly. During isometric contractions of 15 per cent maximum voluntary contraction or less, the blood pressure elevation plus vasodilation of the muscle vascular tissues provides adequate blood flow to meet the metabolic needs of the contracting muscles. At contractions of greater than 15 per cent maximum voluntary contraction, the throttling effect of the mechanical

compression caused by the contracting muscles results in inadequate blood flow to meet the metabolic requirements of the tissues (28). At contractions of 70 per cent maximum voluntary contraction, the intramuscular tension developed during the isometric exercise occludes the blood supply and leads to early fatigue.

Neurological Control of Circulation

In a working muscle, extra blood is needed to ensure its proper functioning. The resultant vasodilation in the working muscle is primarily due to the release of vasoconstrictor tone rather than by activity of vasodilator fibers although these cholinergic fibers do play a part. The peripheral vasoconstriction is mediated by the x-adrenorgic receptors of the peripheral autonomic nervous system (34,35,36,37,38).

Alterations in blood pressure are the result of a reflex response of pressoreceptors and chemoreceptors. As the blood pressure increases, these receptors increase their frequency of firing. These receptors located in the carotid sinus travel to the brain stimulating the central and autonomic nervous systems. This stimulation reduces the effect of the arterial baroreceptors reflex and the result is a rise in both heart rate and blood pressure (39,40,41,42).

The heart rate increase seen with exercise is initiated by the release of vagal tone followed by sympathetic stimulation of the heart. The central control of the heart rate during exercise depends on several factors. The impulses from receptors in joints and the working muscles are received by the brain in proportion to the rate and amount of work performed. Cardio-accelerator reflexes in the carotid and aortic bodies reacting to chemical stimulation can increase the heart rate. Finally, depressor reflexes from the receptors in the carotid sinus and aortic arch can depress the vagal control over the heart enabling the heart to beat faster (43,44,45).

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CHAPTER III

METHODS AND PROCEDURES

Sample Selection

The sample consisted of twenty-four male caucasian volunteer subjects between the ages of twenty-one years and thirty-five years . The program involved one exercise session of isometric exercise followed by three exercise sessions of isokinetic exercise (1,2,3,4,5,6, 7,8). The subjects had no known cardiac, pulmonary or blood pressure problems as determined by a medical questionnaire (9,10,11). Subjects were instructed to refrain from smoking, eating, drinking or exercising for at least four hours prior to each test session (12,13, 14).

Apparatus

The isokinetic apparatus used in the study was the Cybex II system manufactured by the Lumex Corporation. The concept of isokinetic exercise has been discussed previously in Chapter I (page 1-3).

The Cybex II isokinetic system consisted of three components:

1. A dynamometer which measures torque inputs up to 360 foot-pounds. The input attachment supplies a resistance which automatically varies to accommodate the force applied by the subject. Any force applied to the input shaft is recorded on a recorder as well as being displayed on a dial on the front of the dynamometer. The force is recorded as torque in foot-pound units.
2. A speed selector which presets the speed of rotation of the dynamometer from zero to 300 degrees per second (zero to fifty revolutions per minute). The lever arm of the dynamometer cannot be accelerated beyond the set speed regardless of the input torque applied. As more force is exerted against the lever arm of the dynamometer, more resistance is encountered by the subject's limb.
3. A two speed recorder (two millimeters per second and fifty millimeters per second) with heated stylus, records and displays a permanent record of the applied torque.

The recorder of the Cybex apparatus was connected to a Hewlett Packard four channel recorder (model 7754A) by means of a Hewlett Packard bioelectric amplifier (model 8811A) so that the heart rate and torque readings could be recorded simultaneously.

The Cybex II Isokinetic System as used and connected to the four channel recorder is shown in Figure 2. Figure 3 illustrates the permanent record of torque output (channel one), heart rate (Channel two), and heart beats (Channel four) on the paper of the four channel recorder.

Blood pressure measurements were made on a Medisco mercurial sphygmomanometer manufactured in West Germany (Figure 4). The adult blood pressure cuff was placed around the middle third of the upper arm at the level of the heart, evenly and snugly, without constriction. The sphygmomanometer blood pressure cuff was inflated to about 200 millimeters of mercury and the pressure was released at a rate of reduction of about two to three millimeters of mercury per second (15,16,17,18,19,20, 21,22,23).

The sphygmomanometer provided an indirect ausculatory measurement of systolic and diastolic pressure. A review of the literature indicated that the ausculatory method was accurate if performed by the same individual (24,25,26,27). Although the blood pressure readings, when taken by the ausculatory method, were slightly higher than they would have been if taken by the direct method, the ausculatory method was used as it presented less danger to the subjects.

Figure 2: Isokinetic Apparatus

(a) Cybex II Isokinetic Apparatus, Hewlett Packard Four Channel Recorder and Timer

Figure 2: Isokinetic Apparatus

(b) Dynamometer of Isokinetic Apparatus

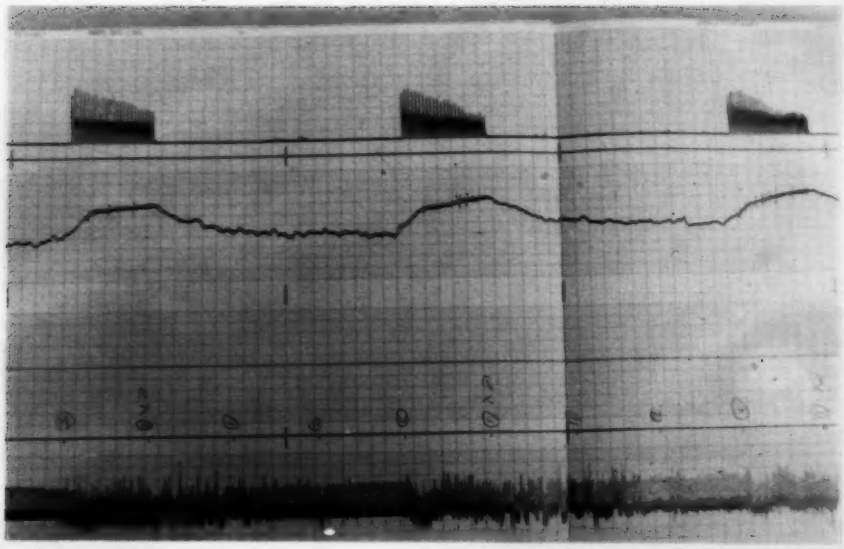

Figure 3: Recording on Four Channel Recorder.
Top Recording is torque output (channel one);
Second Recording is heart rate (channel two);
and Bottom Recording is heart beat
(channel four).

Figure 4: Medisco Mercurial Sphygmomanometer

The first (systolic pressure) and fifth (diastolic pressure) Korotkoff sounds were noted by ausculation of the brachial artery in the anti-cubital fossa.

Heart rate measurements were made on the Hewlett Packard four channel recorder. The electrodes were placed on each subject as shown in Figure 5. The multi-channel lead was attached to a Hewlett Packard bio-electric amplifier (model 8811A) which gave the heart beat reading on channel four. The bioelectric amplifier was attached to a Hewlett Packard rate computer (model 8812A) which gave the heart rate on channel two (Figures 6 and 7).

Initial Familiarization

The twenty-four male subjects came to the strength laboratory in the Faculty of Rehabilitation Medicine, where they were placed in the isokinetic apparatus as shown in Figure 8. The investigator explained the isokinetic principle of maximum resistance through a rull range of motion to the subjects. The investigator then fully explained the experimental procedure to the subjects who were asked to complete a personal data form and to sign an informed consent form (Appendix B and C). The subjects were given an opportunity to prac-

Figure 5: Electrode placement for Recording Heart Rate

Figure 6: Four Channel Recorder Showing Bioelectric Amplifiers and Rate Computer

Figure 7: Connection Between Bioelectric Amplifier and Rate Computer to Record Heart Rate

Figure 8: Subject Placement in Isokinetic Apparatus

tise using the dynamometer at the speeds selected for the project.

Isometric Testing Procedure

Following familiarization of the isokinetic dynamometer, the subject was allowed a rest period of ten minutes. During the first five minutes, the blood pressure cuff and electrocardiogram leads were attached to the subject.

Each subject's left arm rested at their side on a supporting cushion. The adult size blood pressure cuff was placed around the middle third of the upper arm.

The subjects were then seated in the test apparatus and attached to the dynamometer apparatus as shown in Figure 8. The input shaft of the dynamometer was placed lateral to the subject's knee with its axis of rotation coinciding as closely as possible with the axis of rotation of the knee joint (28,29). Each subject was held in position by straps around the waist, the thigh, and the right leg proximal to the ankle. This latter strap attached the subject to the isokinetic apparatus. The position of the back rest of the isokinetic table was adjusted so that the hip angle is between 110 degrees and 120 degrees (30).

Once positioned in the isokinetic apparatus, each

subject was allowed to perform five or six contractions in each direction to allow him to get set and comfortable in the apparatus.

Each subject was then allowed a five minute rest period to allow the heart rate and blood pressure to stabilize near resting levels. During this period the heart rate and blood pressure were recorded every minute. The heart rate was recorded on the minute and the blood pressure cuff was inflated five seconds prior to the minute. The timing of the heart rate and blood pressure measurements was by means of a Gra-Lab Timer (model 171).

While the subject was resting, the angle of the right knee was set at sixty degrees of flexion (full extension considered zero degrees) to prepare for the isometric extensor test. This angle has been found to be the angle which demonstrates the highest isometric force for the knee extensors (31,32,33). To do the isometric test, the angle of the leg was set and the speed selector was set at zero degrees per second.

Following the ten minute rest, the subject was asked to perform one maximum voluntary contraction (MVC) of the quadriceps muscles of the right leg and was asked to hold the contraction as long as possible. The heart

rate and blood pressure were recorded every minute during the contraction.

Following the MVC, each subject was allowed a five minute rest period with heart rate and blood pressure being recorded every minute. During this rest period, the investigator determined seventy percent MVC, thirty percent MVC and ten percent MVC (17, 34,35,36,37,38) (Appendix G).

Following this rest period, each subject was asked to perform one of the percentage MVC of the quadriceps of the right leg. They were asked to hold the contraction for as long as possible to a maximum of three minutes. The percentage MVC was assigned according to a Latin Square design (Appendix K). The heart rate and the blood pressure were noted every minute. Each subject was then allowed another five minute rest period (39).

This procedure was repeated for the other two percentage maximum voluntary contractions (70%, 30% or 10%) to a maximum contraction time of three minutes for each session.

Following completion of the three percentage MVC's for the quadriceps, each subject was given a ten minute rest, five minutes of which could be used to move about, and a second five minutes during which the heart rate and

blood pressure were recorded in the sitting position.

During the second five minute rest, the angle of the right knee was set at forty-five degrees of flexion to prepare for the isometric flexor test. This angle has been found to be the angle which demonstrates the highest isometric force for the knee flexors (31,32, 33). As previously described, the speed selector is set at zero degrees per second for the isometric contraction.

Following the ten minute rest period, each subject was asked to perform one MVC of the hamstrings of the right leg and was asked to hold the contraction as long as possible to a maximum of three minutes. The heart rate and the blood pressure were recorded every minute.

Following the MVC, each subject was allowed another five minute rest period with heart rate and blood pressure being recorded every minute. During this period, the investigator determined 70%, 30% and 10% MVC (Appendix G). For the following three tests, these percentage maximum voluntary contractions were assigned for each subject to do according to the Latin Square design as indicated for the quadriceps muscle group (Appendix K).

Following the second five minute rest, each subject was asked to perform one of the three percentage

maximum voluntary contractions of the hamstrings of the right leg and was asked to hold the contraction as long as possible to a maximum of three minutes. The heart rate and blood pressure were recorded every minute. Each subject was then allowed another five minute rest period during which the heart rate and blood pressure were recorded.

This procedure was repeated for the other two percentage maximum voluntary contractions of the hamstrings as was done with the quadriceps muscle. The time frame for the isometric sessions is illustrated in Figure 9.

Isokinetic Interval Testing Procedure

During the subsequent three visits to the strength laboratory, each subject was asked to perform an isokinetic interval program at three assigned speeds set on the speed selector of the isokinetic apparatus. The three speeds were thirty degrees per second, ninety degrees per second, and 150 degrees per second. The speeds were assigned according to a Latin Square design (Appendix K).

The program for each speed of the Cybex isokinetic dynamometer was the same, only the dynamometer speeds were changed. Each subject did the three isokinetic sessions and the isometric session at the same time of

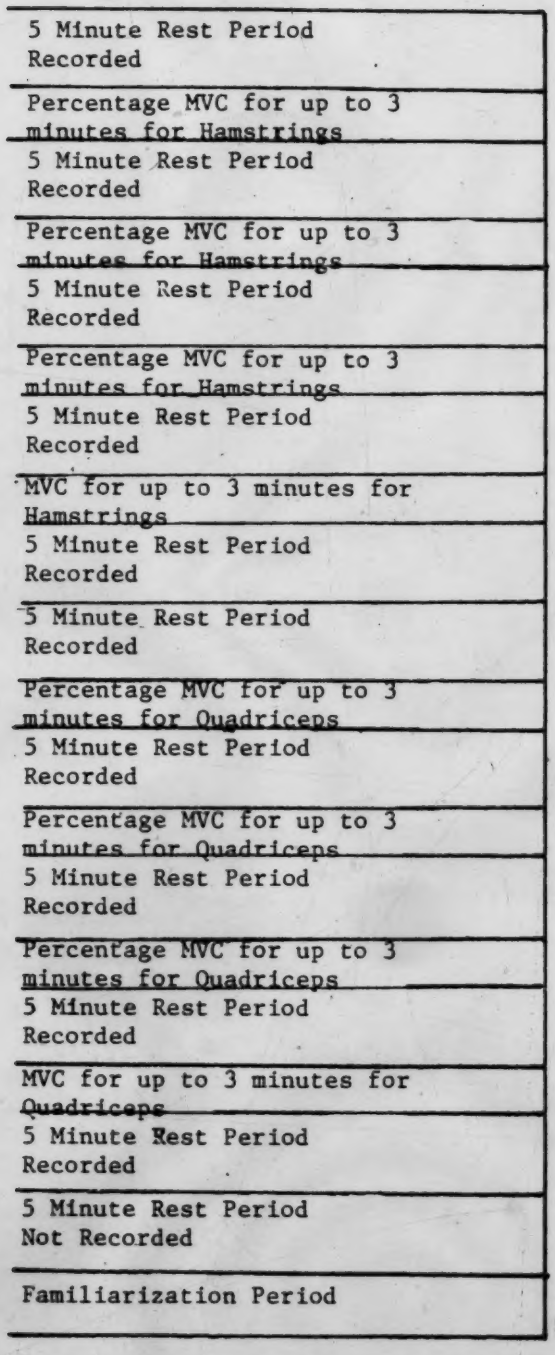
5 Minute Rest Period Recorded
Percentage MVC for up to 3 minutes for Hamstrings
5 Minute Rest Period Recorded
Percentage MVC for up to 3 minutes for Hamstrings
5 Minute Rest Period Recorded
Percentage MVC for up to 3 minutes for Hamstrings
5 Minute Rest Period Recorded
MVC for up to 3 minutes for Hamstrings
5 Minute Rest Period Recorded
5 Minute Rest Period Recorded
Percentage MVC for up to 3 minutes for Quadriceps
5 Minute Rest Period Recorded
Percentage MVC for up to 3 minutes for Quadriceps
5 Minute Rest Period Recorded
Percentage MVC for up to 3 minutes for Quadriceps
5 Minute Rest Period Recorded
MVC for up to 3 minutes for Quadriceps
5 Minute Rest Period Recorded
5 Minute Rest Period Not Recorded
Familiarization Period
Start

Figure 9: Time Frame for Isometric Sessions
Total Time: 75 Minutes

day but on different days (40).

Each subject was positioned as previously described for the isometric test (Figure 8), and the electrocardiograph electrodes and blood pressure cuff were positioned as previously described.

Once positioned in the isokinetic apparatus, each subject was allowed to perform five or six contractions at the selected speed in each direction (flexion and extension of the knee) through a full range of motion to allow the subject to become comfortable and adjusted in the apparatus.

Each subject was then allowed a five minute rest period to allow the heart rate and blood pressure to stabilize at a normal resting level. During this period the heart rate and blood pressure was recorded every minute. The heart rate was recorded on the minute and the blood pressure cuff was inflated five seconds prior to the minute.

Following the five minute rest period, each subject was asked to flex and extend his right knee through a full range of motion as hard and as fast as he could for one minute at one of the designated speeds. The subject was then allowed a three minute rest-relief period (41). The heart rate and blood pressure were recorded every minute during the rest period and contraction time.

The process of work and rest-relief were continued for a total of three sets (41). Following completion of the third set, heart rate and blood pressure were recorded until both returned to near pre-exercise levels.

On the subsequent two visits, the program was the same as described above, but with different dynamometer speeds. The time frame for the Isokinetic Interval training sessions is illustrated in Figure 10.

Statistical Treatment

One-way, two-way and three-way analyses of variance with repeated measures on one factor were used to analyse the data. These methods are described in Winer (42). These methods offer the advantage of each subject acting as his own control. Thus the variability due to average different responses of all subjects is eliminated from the experimental error.

The data was tested at the .01 level of significance for the analysis of variance as well as for the Tukey Test and Scheffe Test.

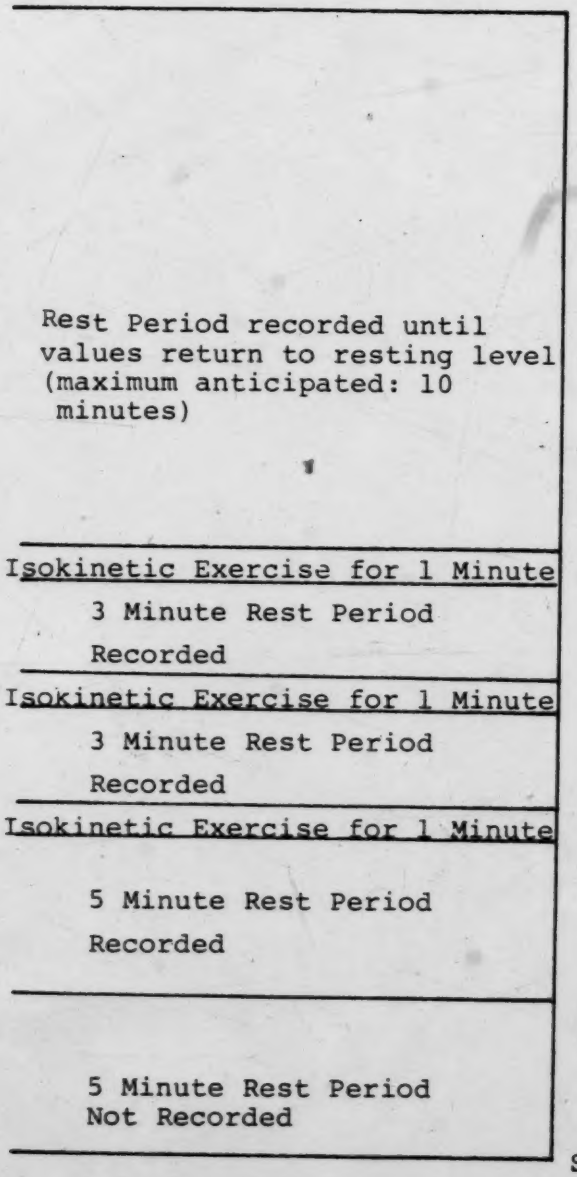
Rest Period recorded until values return to resting level (maximum anticipated: 10 minutes)
Isokinetic Exercise for 1 Minute
3 Minute Rest Period Recorded
Isokinetic Exercise for 1 Minute
3 Minute Rest Period Recorded
Isokinetic Exercise for 1 Minute
5 Minute Rest Period Recorded
5 Minute Rest Period Not Recorded
Start

Figure 10: Time Frame for Isokinetic Interval Training
Total Time/Session: 30 Minutes

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CHAPTER IV

RESULTS

The purpose of this study was to determine the effect of isokinetic exercise on heart rate and blood pressure at three different speeds of movement and to determine if an isokinetic interval program had a cumulative effect on heart rate and blood pressure. In addition, the quadriceps and hamstring muscle groups were tested isometrically on the Cybex II isokinetic apparatus. The effects of isometric exercise on heart rate and blood pressure were observed and compared with the results found in previous studies. A sample of twenty-four subjects was studied.

The results and discussion will be divided into three parts as follows (a) effect of isometric exercise on heart rate and blood pressure; (b) effect of isokinetic exercise on heart rate and blood pressure and; (c) comparison of the effect of isometric and isokinetic exercise on heart rate and blood pressure. The raw data and format statements for each procedure are found in appendices L and M respectively.

Effect of Isometric Exercise on Heart Rate and Blood Pressure

The method used for the statistical analysis of

the data for heart rate during isometric rest periods was a two-way analysis of variance on repeated measures. In the analysis, the terms groups and trials refer to the following: (1) Group - in the testing of isometric exercise, there were five rest periods. The first rest period was pre-exercise or pre-maximum voluntary contraction. The second, third, and fourth rest periods were pre-seventy percent, pre-thirty percent and pre-ten percent respectively. The final rest period was the post-test reading. (2) Trials refers to the five readings for each subject within each group. That is, each subject had five resting values for each of the rest periods.

Table I shows the values obtained in the two-way analysis of variance for heart rate using quadriceps and hamstring muscle groups. Significant interaction occurred between each of the groups over the five trials with no pattern emerging. Primary interaction was between the post-test values.

The method used for the statistical analysis of the data for systolic and diastolic blood pressure during isometric rest periods was a two-way analysis of variance on repeated measures. In the analysis, the terms groups and trials refer to the same terms as used in the analysis of heart rate data for isometric rest periods.

Table I

Analysis of Variance for Heart Rate During Isometric Rest Periods for (1) Quadriceps and (2) Hamstring Muscle Groups

SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARES	F RATIO	PROBABILITY
1. Quadriceps					
GROUPS	634.500	4.	158.625	0.256	0.906
	71357.000	115.	620.496		
TRIALS	2101.501	4.	525.375	12.190	0.001
GROUPS/TRIALS INTERACTION	4765.500	16.	297.844	6.911	0.001
	19825.000	460.	43.098		
2. Hamstrings					
GROUPS	571.500	4.	142.875	0.272	0.896
	60425.000	115.	525.435		
TRIALS	2799.002	4.	699.750	16.477	0.001
GROUPS/TRIALS INTERACTION	2809.502	16.	175.594	4.135	0.001
	19536.000	460.	42.470		

Table II shows the values obtained in the two-way analysis of variance for systolic and diastolic blood pressure using quadriceps and hamstring muscle groups. Significant interaction for systolic blood pressure occurred primarily between the pre-test value and the first post-test value. As well, for trials three, four, and five, interaction did occur between the post-test values for the quadriceps muscle group. For the hamstrings muscle group, the interaction for systolic blood pressure was between the pre-exercise value and the post-exercise values.

The method used for the statistical analysis of the data for mean blood pressure, modified tension time index, and pulse pressure during isometric rest periods using quadriceps and hamstring muscle groups was a one-way analysis of variance on repeated measures. In the analysis, the term trials refers to the rest periods.

Table III shows the values obtained in the one-way analysis of variance for mean blood pressure, modified tension time index and pulse pressure for quadriceps and hamstrings muscle groups.

A Tukey Test performed on the trials for mean blood pressure, modified tension time index, and pulse pressure during isometric rest periods showed a

Table II

Analysis of Variance for (a) Systolic Blood Pressure and (b) Diastolic Blood Pressure During Isometric Rest Periods Using (1) Quadriceps and (2) Hamstring Muscle Groups

SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARES	F RATIO	PROBABILITY
1. Quadriceps					
(a) Systolic Blood Pressure					
GROUPS	4489.500	4.	1122.375	2.133	0.081
	60500.000	115.	526.087		
TRIALS	2517.001	4.	629.250	46.128	0.001
GROUPS/TRIALS INTERACTION	1243.501	16.	77.719	5.697	0.001
	6275.000	460.	13.641		
(b) Diastolic Blood Pressure					
GROUPS	454.500	4.	113.625	0.312	0.869
	41842.000	115.	363.843		
TRIALS	99.000	4.	24.750	1.970	0.098
GROUPS/TRIALS INTERACTION	277.500	16.	17.344	1.381	0.146
	5779.000	460.	12.563		

Table II continued

SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARES	F RATIO	PROBABILITY
2. Hamstrings					
(a) Systolic Blood Pressure					
GROUPS	1609.501	4.	402.375	0.907	0.463
	51028.000	115.	443.722		
TRIALS	1639.501	4.	409.875	32.773	0.001
GROUPS/TRIALS INTERACTION	618.000	16.	38.625	3.088	0.001
	5753.000	460.	12.507		
(b) Diastolic Blood Pressure					
GROUPS	208.500	4.	52.125	0.141	0.967
	42548.000	115.	369.982		
TRIALS	18.000	4.	4.500	0.388	0.817
GROUPS/TRIALS INTERACTION	208.500	16.	13.031	1.125	0.329
	5329.000	460.	11.585		

Table III

Analysis of Variance for (a) Mean Blood Pressure, (b) Modified Tension Time Index, and (c) Pulse Pressure During Isometric Rest Periods Using (1) Quadriceps and (2) Hamstring Muscle Groups

SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARES	F RATIO	PROBABILITY
1. Quadriceps					
(a) Mean Blood Pressure					
	39711.000	119.	33.706		
TRIALS	371.250	4.	92.813	11.075	0.001
	3989.000	476.	8.380		
(b) Modified Tension Time Index					
	129327.000	119.	1086.781		
TRIALS	5980.781	4.	1495.195	16.087	0.001
	42347.000	476.	88.964		
(c) Pulse Pressure					
	45937.000	119.	386.027		
TRIALS	2280.000	4.	570.000	24.565	0.001
	11044.938	476.	23.204		

Table III continued

SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARES	F RATIO	PROBABILITY
2. Hamstrings					
(a) Mean Blood Pressure					
	36839.000	119.	309.571		
TRIALS	190.781	4.	47.695	6.636	0.001
	3421.000	476.	7.187		
(b) Modified Tension Time Index					
	96552.000	119.	811.361		
TRIALS	4498.125	4.	1124.531	13.920	0.001
	38454.000	476.	80.786		
(c) Pulse Pressure					
	41063.750	119.	345.073		
TRIALS	1655.625	4.	413.906	18.680	0.001
	10547.063	476.	22.158		

significant difference occurred between those trials shown in Table IV. The differences in mean blood pressure, modified tension time index and pulse pressure for quadriceps and hamstring muscle groups are shown in Figures 11, 12, and 13, respectively.

As indicated in Figure 11, the pre-exercise mean blood pressure value for the quadriceps muscle group was found to be significantly different from the post-exercise values. Furthermore, no significant differences were found among the post-exercise mean blood pressure values. For the hamstring muscle group, the pre-exercise mean blood pressure value was found to be significantly different from the last three post-exercise mean blood pressure values. No significant differences were found between the post-exercise mean blood pressure values for the hamstrings muscle group.

The pre-exercise modified tension time index value for the quadriceps muscle group was found to be significantly different from the following three post-exercise values. The pre-exercise value was not significantly different from the final post-test value. The third and fourth post-exercise modified tension time indices were significantly different from the final

Table IV

Significant Differences Between Trials Using Tukey Test* for Mean Blood Pressure, Modified Tension Time Index, and Pulse Pressure During Isometric Rest Periods Using Quadriceps and Hamstring Muscle Groups

QUADRICEPS	HAMSTRINGS
(a) Mean Blood Pressure	(a) Mean Blood Pressure
98.196 - 96.756	97.022 - 95.857
98.196 - 95.993	97.022 - 95.352
98.196 - 96.195	97.002 - 95.687
98.196 - 96.375	
*critical value = 1.22 @ α = .01	*critical value = 1.13 @ α = .01
(b) Modified Tension Time Index	(b) Modified Tension Time Index
89.493 - 84.768	83.460 - 79.423
89.493 - 81.533	83.460 - 79.694
89.493 - 80.983	83.460 - 77.470
81.533 - 86.441	79.423 - 84.844
80.983 - 86.441	79.694 - 84.844
*critical difference = 3.96 @ α = .01	*critical value = 3.77 @ α = .01
(c) Pulse Pressure	(c) Pulse Pressure
44.133 - 41.408	41.008 - 37.992
44.133 - 40.633	41.008 - 37.558
44.133 - 39.025	41.008 - 36.842
44.133 - 38.717	41.008 - 36.200
41.408 - 39.025	
41.408 - 38.717	
*critical value = 2.02 @ α = .01	*critical value = 1.98 @ α = . 01

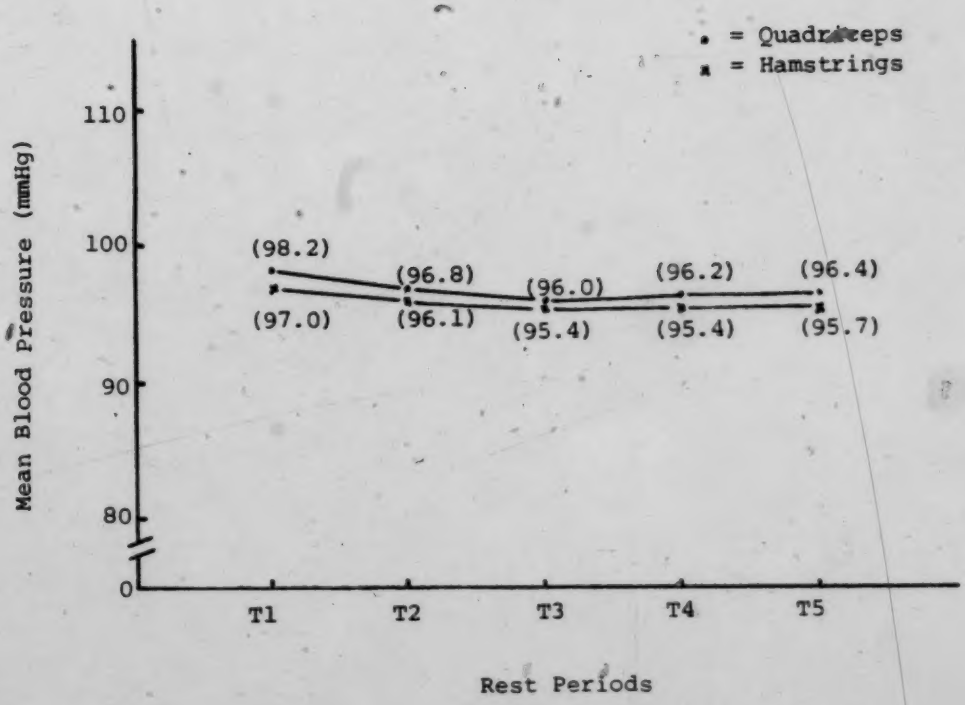

Figure 11: Mean Blood Pressure During Isometric Rest Periods Using Quadriceps and Hamstring Muscle Groups

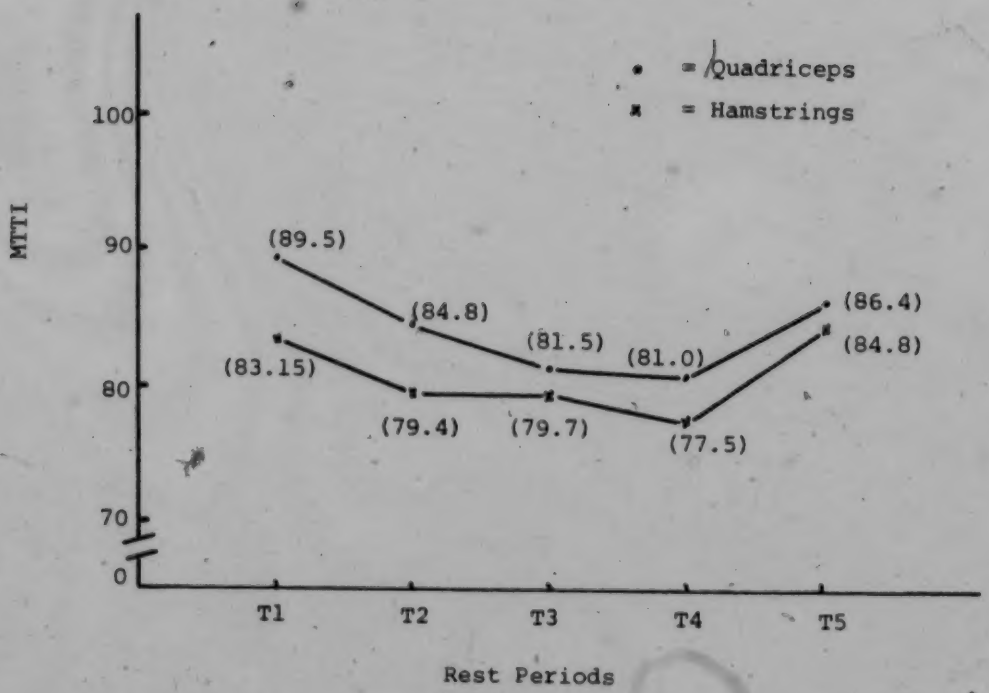

Figure 12: Modified Tension Time Index During Isometric Rest Periods Using Quadriceps and Hamstring Muscle Groups

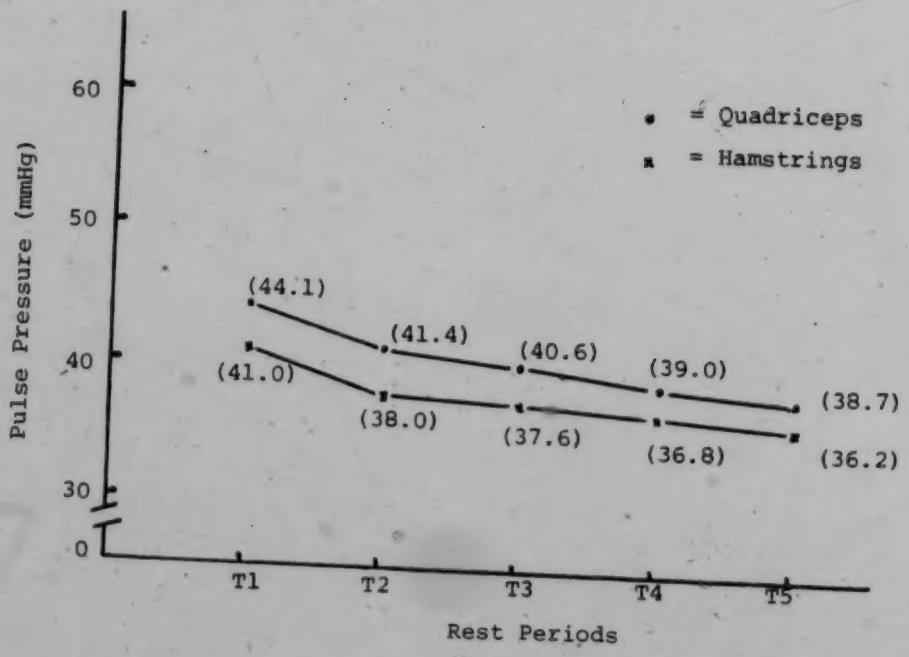

Figure 13: Pulse Pressure During Isometric Rest Periods Using Quadriceps and Hamstring Muscle Groups

post-exercise values. Similarly, the pre-exercise modified tension time index for the hamstring muscle group was found to be significantly different from the following three post-exercise values. Again, the pre-exercise modified tension time index was not significantly different from the final post-exercise value. The second and third post-exercise modified tension time indices were significantly different from the final post-exercise value.

As indicated in Figure 13, the pre-exercise pulse pressure for the quadriceps muscle group was found to be significantly different from the post-exercise values. As well, the first post-exercise value was found to be significantly different from the final three post-exercise values. There were no significant differences between the final three post-exercise values. For the hamstring muscle group, the pre-exercise pulse pressure was significantly different from the post-exercise values. There were no significant differences between the post-exercise pulse pressure values.

The method used for the statistical analysis of the data for heart rate during isometric exercise using the quadriceps and hamstrings was a one-way analysis of variance on repeated measures. In the analysis,

the term treatment refers to the percentage strength of the isometric contraction. Trial one is maximum voluntary contraction (MVC); trial two is seventy percent MVC; trial three is thirty percent MVC; and, trial four is ten percent MVC.

Table V shows the values obtained in the one-way analysis of variance for heart rate during isometric exercise bouts using quadriceps and hamstrings.

A Tukey Test performed on the trials for the heart rate during isometric exercise bouts showed a significant difference occurred between those trials shown in Table VI.

As indicated in Figure 14, for the quadriceps muscle group, there were significant differences in heart rate between MVC, and thirty and ten percent MVC; between seventy percent MVC, and thirty and ten percent MVC, and; between thirty percent MVC and ten percent MVC. For the hamstring muscle groups, there were significant differences in heart rate between MVC, and seventy, thirty, and ten percent MVC, and between seventy percent MVC and, thirty and ten percent MVC.

The method used for the statistical analysis of the data for systolic and diastolic blood pressure during isometric exercise bouts using quadriceps and hamstring muscle groups was a one-way analysis of variance

Table V

Analysis of Variance for Heart Rate During Isometric Exercise Bouts using (1) Quadriceps and (2) Hamstring Muscle Groups

SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARES	F RATIO	PROBABILITY
1. Quadriceps					
	21641.688	23.	940.943		
TREATMENT	42543.375	3.	14181.125	93.963	0.001
	10413.688	69.	150.923		
2. Hamstrings					
	15599.375	23.	678.234		
TREATMENT	36083.438	3.	12027.813	71.405	0.001
	11622.625	69.	168.444		

Table VI

Significant Differences Between Treatments Using Tukey Test* for Heart Rate During Isometric Exercise Bouts Using Quadriceps and Hamstring Muscle Groups

QUADRICEPS	HAMSTRINGS
120.208 - 85.000	114.917 - 101.625
120.208 - 69.208	114.917 - 73.917
114.833 - 85.000	114.917 - 67.875
114.833 - 69.208	101.625 - 73.917
85.000 - 69.208	101.625 - 67.875
*critical value = 11.51 @ α = .01	*critical value = 12.16 @ α =.01

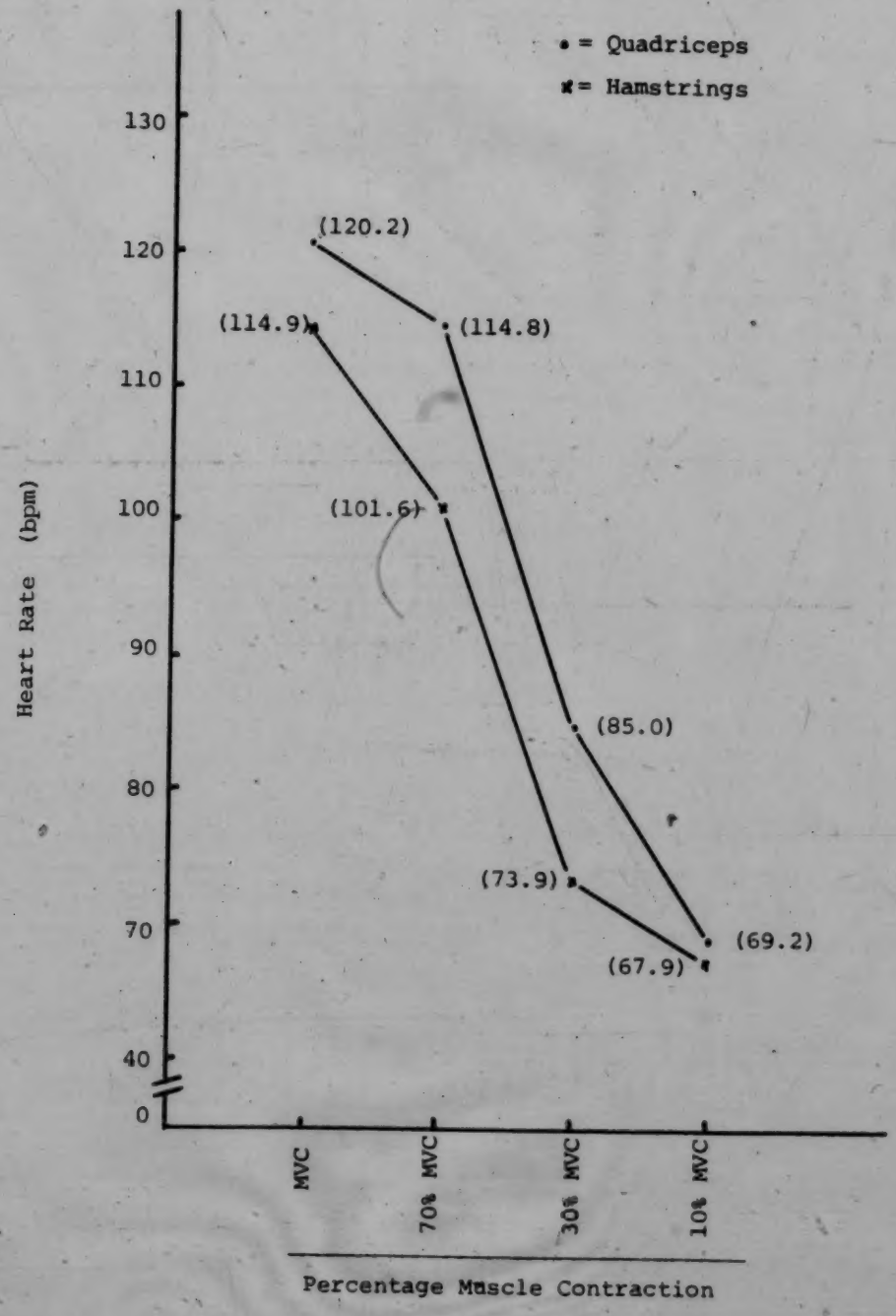

Figure 14: Heart Rate During Isometric Exercise Bouts Using Quadriceps and Hamstring Muscle Groups (MVC = maximum voluntary contraction)

on repeated measures. In the analysis, the term rest refers to the percentage strength of isometric contraction as the term treatment previously did in isometric exercise heart rate.

Table VII shows the values obtained in the one-way analysis of variance for systolic and diastolic blood pressure for quadriceps and hamstrings muscle groups.

A Tukey Test performed on the trials for systolic and diastolic blood pressure during isometric exercise bouts showed a significant difference occurred between those trials shown in Table VIII.

As indicated in Figure 15, for the quadriceps muscle group, there were significant differences in the systolic blood pressure between MVC, and thirty and ten percent MVC, and between seventy percent MVC and thirty and ten percent MVC. For diastolic blood pressure, the quadriceps muscle group showed significant differences between MVC, and thirty and ten percent MVC; between seventy percent MVC, and thirty and ten percent MVC; and, between thirty percent MVC and ten percent MVC.

For the hamstring muscle group, there were significant differences in the systolic blood pressure between MVC and seventy, thirty, and ten percent MVC; between seventy percent MVC, and thirty and ten percent

Table VII

Analysis of Variance for (a) Systolic Blood Pressure and (b) Diastolic Blood Pressure During Isometric Exercise Bouts Using (1) Quadriceps and (2) Hamstring Muscle Groups

SOURCE	SUM OF SQUARES	DEGREES OF FREEDON	MEAN SQUARES	F RATIO	PROBABILITY
1. Quadriceps					
(a) Systolic					
	13538.000	23.	588.609		
REST	13764.000	3.	4588.000	40.986	0.001
(Treatment)	7724.000	69.	111.942		
(b) Diastolic					
	4404.438	23.	239.323		
REST	9848.813	3.	3282.938	41.544	0.001
(Treatment)	5452.563	69.	79.023		
2. Hamstrings					
(a) Systolic					
	9173.000	23.	398.826		
REST	17487.000	3.	5829.000	77.720	0.001
(Treatment)	5175.000	69.	75.000		
(b) Diastolic					
	5697.938	23.	247.736		
REST	14813.063	23.	4937.688	76.681	0.001
(Treatment)	4443.063	69.	64.392		

Table VIII

Significant Differences Between Trials (Rest) Using Tukey Test* for (1) Systolic Blood Pressure and (2) Diastolic Blood Pressure During Isometric Exercise Bouts Using Quadriceps and Hamstring Muscle Groups

QUADRICEPS	HAMSTRINGS
Systolic Blood Pressure	Systolic Blood Pressure
160.917 - 140.33	159.874 - 145.042
160.917 - 130.667	159.875 - 134.000
155.292 - 140.333	159.875 - 123.458
155.292 - 130.667	145.042 - 134.000
	145.042 - 123.458
	134.000 - 123.458
*critical value = 9.91 @ α =.01	*critical value = 8.11 @ α =.01
Diastolic Blood Pressure	Diastolic Blood Pressure
115.250 - 99.333	115.542 - 106.917
115.250 - 89.417	115.542 - 88.833
111.042 - 99.333	115.542 - 85.667
111.042 - 89.417	106.917 - 88.833
99.333 - 89.417	106.917 - 85.667
*critical value = 8.33 @ α = .01	*critical value = 7.52 @ α = .01

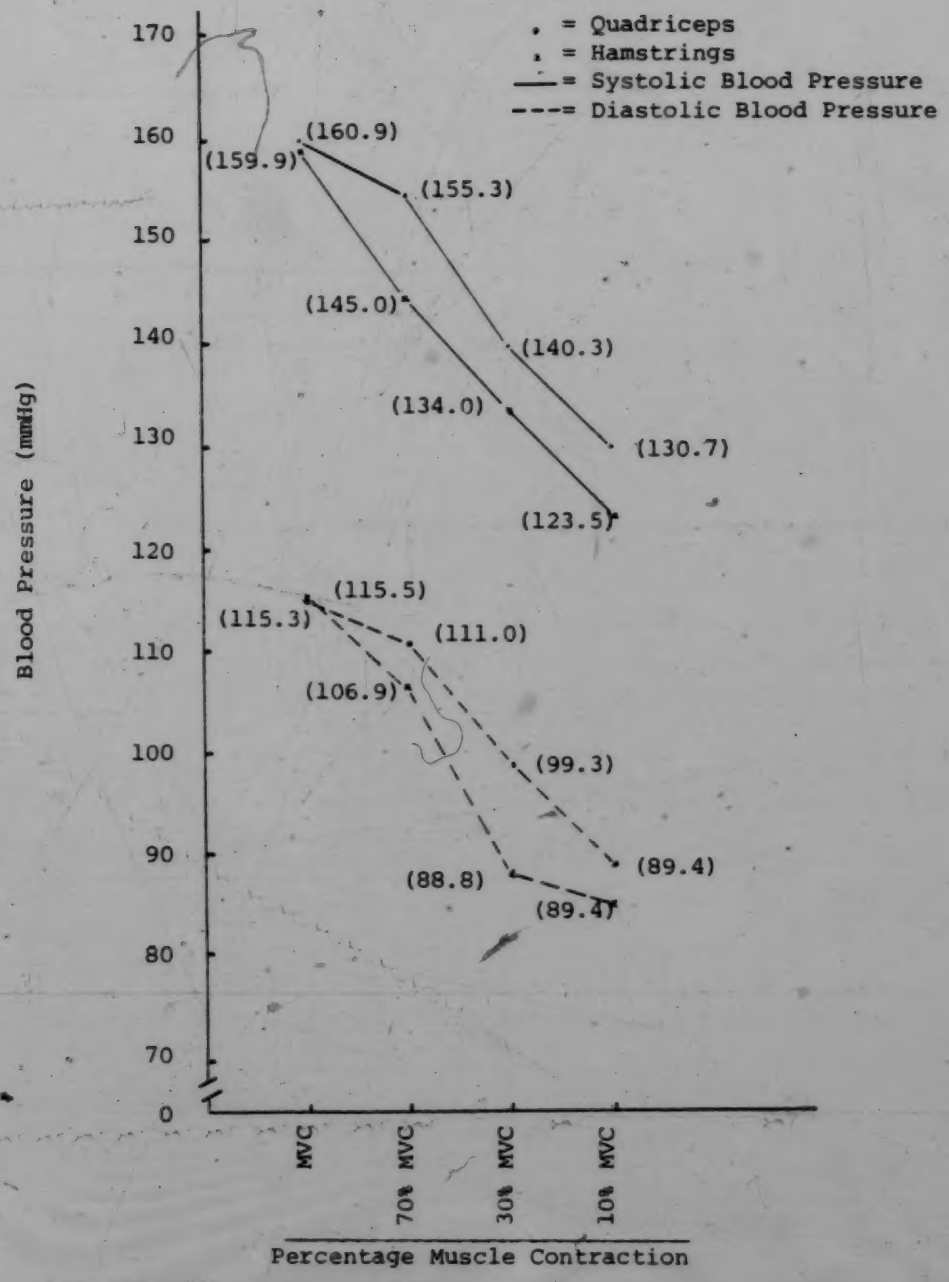

Figure 15: Systolic and Diastolic Blood Pressure During Isometric Exercise Bouts Using Quadriceps and Hamstring Muscle Groups (MVC = maximum voluntary contraction)

MVC; and, between thirty percent MVC and ten percent MVC. For diastolic blood pressure, the hamstrings muscle group showed significant differences between MVC, and seventy, thirty, and ten percent MVC and, between seventy percent MVC and thirty and ten percent MVC.

The method used for the statistical analysis of the data for mean blood pressure, modified tension time index, and pulse pressure during isometric exercise bouts using quadriceps and hamstring muscle groups was a one-way analysis of variance on repeated measures. In the analysis, the term trials refers to the percentage strength of isometric contraction as the term treatment previously did in isometric exercise heart rate.

Table IX shows the values obtained in the one-way analysis of variance for mean blood pressure, modified tension time index, and pulse pressure for quadriceps and hamstring muscle group.

A Tukey Test performed on the trials for mean blood pressure, modified tension time index, and pulse pressure during isometric exercise bouts showed a significant difference occurred between those trials shown in Table X. The differences in mean blood pressure and modified tension time index for quadriceps

Table IX

Analysis of Variance for (a) Mean Blood Pressure, (b) Modified Tension Time Index, and (c) Pulse Pressure During Isometric Exercise Bouts Using (1) Quadriceps and (2) Hamstrings Muscle Groups

SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARES	F RATIO	PROBABILITY
1. Quadriceps					
(a) Mean Blood Pressure					
	6692.000	23.	290.956		
TRIALS	11047.969	3.	3682.656	53.744	0.001
	4728.000	69.	68.522		
(b) Modified Tension Time Index					
	55412.000	23.	2409.217		
TRIALS	171765.000	3.	57255.000	86.226	0.001
	45817.000	69.	664.014		
(c) Pulse Pressure					
	6634.375	23.	288.451		
TRIALS	377.438	3.	125.813	1.312	0.278
	6618.000	69.	95.913		

Table IX continued

SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARES	F RATIO	PROBABILITY
2. Hamstrings					
(a) Mean Blood Pressure					
	5620.000	23.	244.348		
TRIALS	15425.906	3.	5141.969	94.361	0.001
	3760.000	69.	54.493		
(b) Modified Tension Time Index					
	40019.000	23.	1739.956		
TRIALS	153214.500	3.	51071.500	81.362	0.001
	43312.000	69.	627.710		
(c) Pulse Pressure					
	1116.656	3.	372.219	6.222	0.001
TRIALS	4127.750	69.	59.822		

Table X

Significant Differences Between Trials Using Tukey Test* for Mean Blood Pressure, Modified Tension Time Index and Pulse Pressure During Isometric Exercise Bouts Using Quadriceps and Hamstring Muscle Groups

QUADRICEPS	HAMSTRINGS
(a) Mean Blood Pressure	(a) Mean Blood Pressure
130.342 - 112.887	130.190 - 119.506
130.342 - 103.063	130.190 - 103.785
125.665 - 112.887	130.190 - 98.116
125.665 - 103.063	119.505 - 103.785
112.887 - 103.063	119.505 - 98.166
*critical value = 7.76 @ α = .01	*critical value = 6.92 @ α =.01
(b) Modified Tension Time Index	(b) Modified Tension Time Index
193.694 - 119.017	184.261 - 148.103
193.694 - 90.570	184.261 - 98.897
178.900 - 119.017	184.261 - 83.619
178.900 - 90.570	148.103 - 98.897
119.017 - 90.570	148.103 - 83.619
*critical value = 24.14 @ α = .01	*critical value = 23.47 @ α =.01
(c) Pulse Pressure	(c) Pulse Pressure
no significance	45.167 - 37.792
	*critical value = 7.25 @ α = .01

and hamstring muscle groups are shown in Figures 16 and 17.

As shown in Figure 16, for the quadriceps muscle group, there were significant differences in the mean blood pressure between MVC, and thirty and ten percent MVC; between seventy percent, and thirty and ten percent MVC; and, between thirty percent MVC and ten percent MVC. For the hamstrings muscle group, there were significant differences between MVC, and seventy, thirty, and ten percent MVC, and between seventy percent MVC, and thirty and ten percent MVC.

For the quadriceps muscle group, there were significant differences in the modified tension time index between MVC, and thirty and ten percent MVC; between seventy percent MVC, and thirty and ten percent MVC; and, between thirty percent MVC and ten percent MVC. For the hamstring muscle group, there were significant differences between MVC, and seventy, thirty, and ten percent MVC, and between seventy percent MVC, and thirty and ten percent MVC. There is no significant difference in pulse pressure between the percentage contractions for the quadriceps muscle group. For the hamstring muscle group, there is a significant difference in pulse pressure between thirty percent MVC and ten percent MVC only.

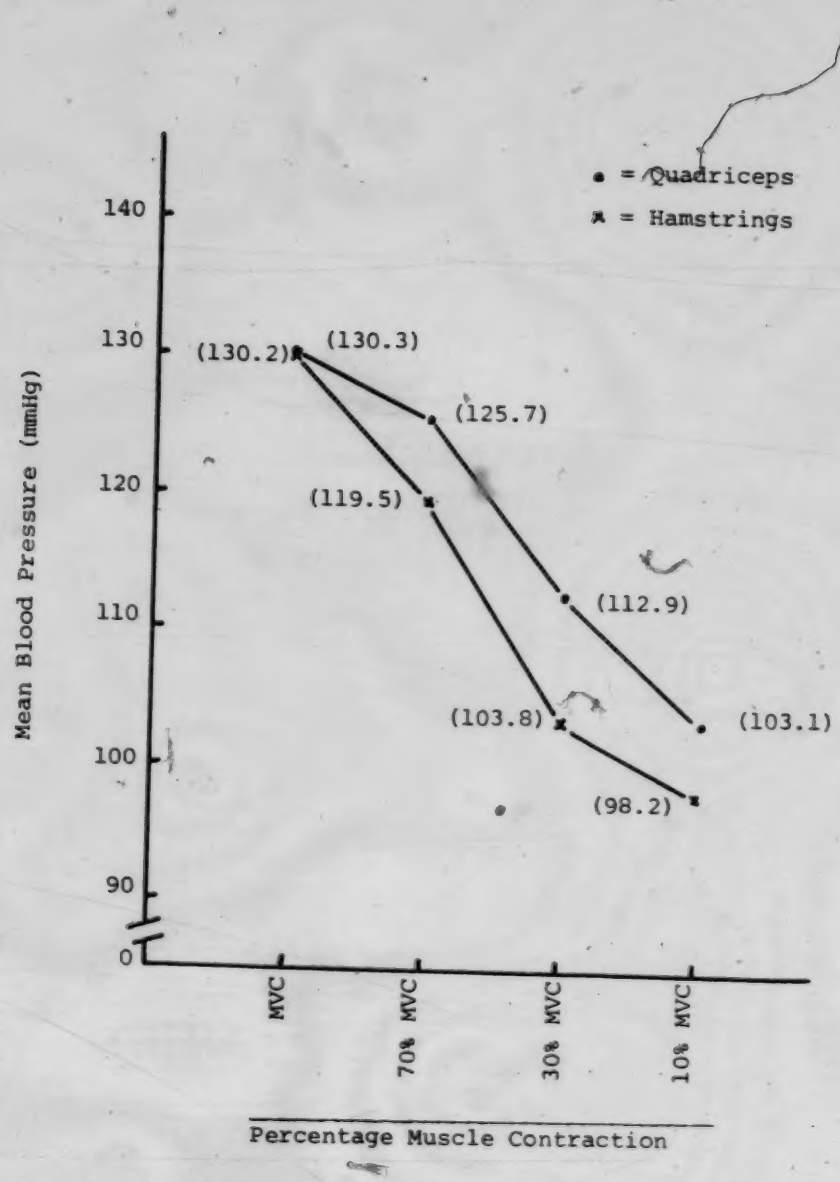

Figure 16: Mean Blood Pressure During Isometric Exercise Bouts Using Quadriceps and Hamstring Muscle Groups (MVC = maximum voluntary contraction)

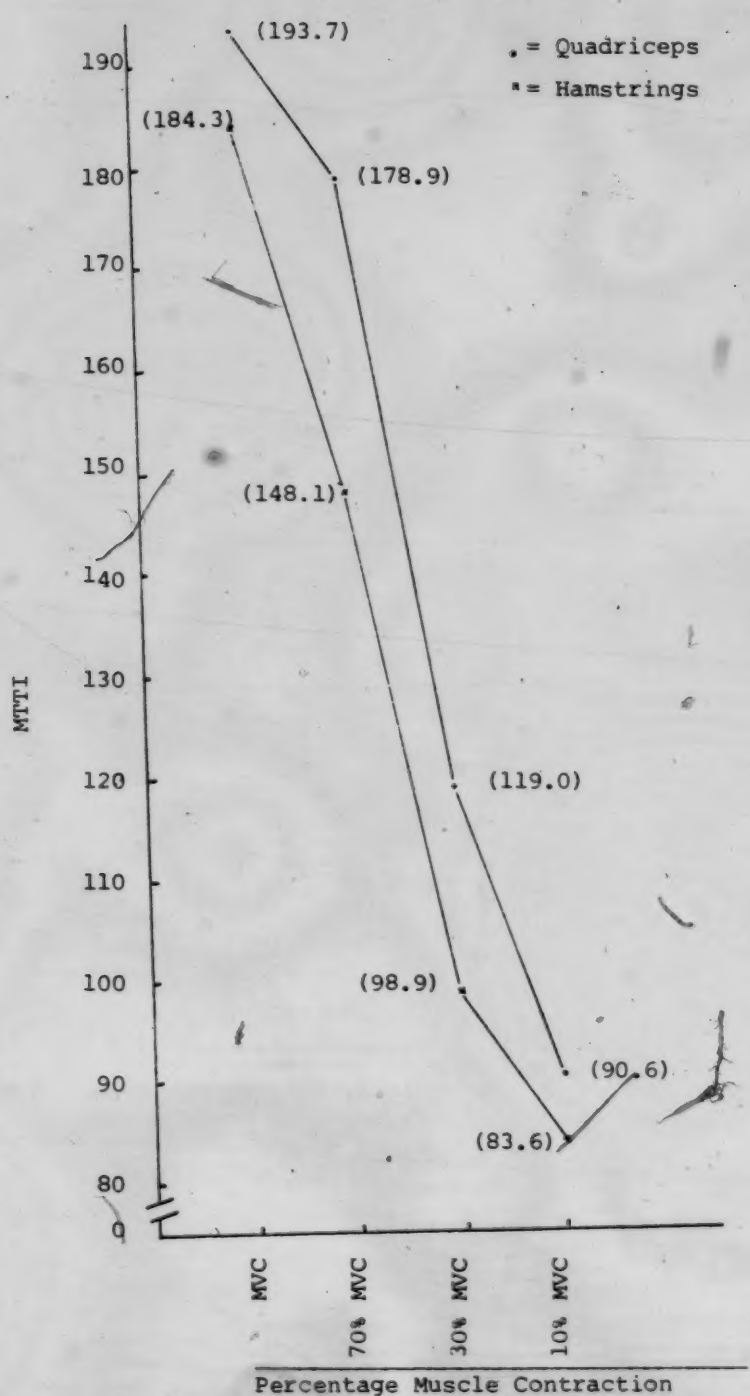

Figure 17: Modified Tension Time Index During Isometric Exercise Bouts Using Quadriceps and Hamstring Muscle Groups (MVC = maximum voluntary contraction)

Effect of Isokinetic Exercise on Heart Rate and Blood Pressure

The method used for the statistical analysis of the data for heart rate during isokinetic rest periods was a three-way analysis of variance on repeated measures. In the analysis, the terms speed, rest, and trials refer to the following: (1) speed - three speeds were chosen for the isokinetic apparatus - 30 degrees per second (low), 90 degrees per second (medium), and 150 degrees per second (high); (2) rest - the rest periods were set up as follows: one rest period of three minutes duration prior to exercise, one rest period of three minutes duration following each of the first two isokinetic exercise bouts, and three rest periods of three minutes each following the third exercise bout. This sequence was used to establish an isokinetic interval program of one minute followed by a three minute rest with the final three-three minute rest periods used to allow the heart rate and blood pressure return to near resting levels; (3) Trials refers to the order in which the selected speed of isokinetic exercise was performed during the isokinetic interval session for that particular test day.

Table XI shows the values obtained in the three-way analysis of variance for heart rate during isokinetic rest periods. Significant differences were

Table XI

Analysis of Variance for Heart Rate During Isokinetic Rest Periods

SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARES	F RATIO	PROBABILITY
	176233.00	23.	7662,301		
SPEED	11625.000	2.	5812.500	7.860	0.001
	34019.000	46.	739.532		
REST	79564.500	5.	15912.898	71.134	0.001
	25726.000	115.	223.704		
SPEED/REST INTERACTION	6075.000	10.	607.500	10.067	0.001
	13880.000	230.	60.348		
TRIALS	4770.000	2.	2385.000	28.131	0.001
	3900.000	46.	84.783		
SPEED/TRIALS INTERACTION	336.000	4.	84.000	2.204	0.075
	3507.000	92.	38.120		
REST/TRIALS INTERACTION	9954.000	10.	995.400	22.329	0.001
	10253.000	230.	44.578		
REST/SPEED/ TRIALS INTER-ACTION	582.000	20.	29.100	0.799	0.716
	16757.000	460.	36.428		

found between the different speeds, between the different rest periods, and between the different trials. Significance in the interaction was found between speed and rest, and rest and trials.

The data showed that the significant interaction between speed and rest occurred primarily between the initial rest period and the first post-exercise period. There was also an interaction between the first and second post-exercise rest periods for the medium and high speeds.

For the interaction between rest and trials, the main significant interaction occurred between the pre-exercise period or initial rest period and the first post-test exercise period, as well as between the second post-exercise rest period and the third post-exercise period.

The method used for statistical analysis of the data for both systolic and diastolic blood pressure during isokinetic rest periods was a three-way analysis of variance on repeated measures. In the analysis, the terms speed, rest, and trials refer to the same terms as used in analysis of heart rate data for isokinetic rest periods.

Table XII shows the values obtained in the three-way analysis of variance for systolic blood pressure during isokinetic rest periods. Significant differences were found between the different speeds, between the different rest periods, and between the different trials. Significance in the interaction was found between speed and rest, and rest and trials.

The data showed that the significant interaction between speed and rest occurred primarily between the initial rest period and the first post-exercise period. The main significant interaction between rest and trials occurred again between the pre-exercise rest period and the first post-test period.

Table XIII shows the values obtained in the three-way analysis of variance for diastolic blood pressure during isokinetic rest periods. Significant differences were found only between the different rest periods.

The method of statistical analysis of the data for mean blood pressure, modified tension time index, and pulse pressure during isokinetic rest periods was a one-way analysis of variance on repeated measures. In the analysis, the term trials refers to the rest periods before and after the exercise bouts. There was one rest period of three minutes duration prior to

Table XII

Analysis of Variance for Systolic Blood Pressure During Isokinetic Rest Periods

SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARES	F RATIO	PROBABILITY
	99904.000	23.	4343.648		
SPEED	8914.500	2.	4457.250	10.301	0.001
	19904.000	46.	432.696		
REST	160503.000	5.	32100.598	152.092	0.001
	24272.000	115.	211.061		
SPEED/REST INTERACTION	4299.000	10.	429.900	6.609	0.001
	14960.000	230.	65.043		
TRIALS	25054.500	2.	12527.250	290.450	0.001
	1984.000	46.	43.130		
SPEED/TRIALS INTERACTION	57.000	4.	14.250	0.635	0.639
	2064.000	92.	22.435		
REST/TRIALS INTERACTION	13965.000	10.	1396.500	76.330	0.001
	4208.000	230.	18.296		
SPEED/REST/ TRIALS INTER-ACTION	189.000	20.	9.450	0.536	0.951
	8112.000	460.	17.635		

Table XIII

Analysis of Variance for Diastolic Blood Pressure During Isokinetic Rest Periods

SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARES	F RATIO	PROBABILITY
	110651.000	23.	4810.910		
SPEED	1951.500	2.	975.750	0.944	0.396
	47547.000	46.	1033.630		
REST	18972.000	5.	3794.400	4.697	0.001
	92903.000	115.	807.852		
SPEED/REST	6681.000	10.	668.100	0.947	0.491
	162342.000	230.	705.835		
TRIALS	1452.000	2.	726.000	0.948	0.391
	34866.000	46.	757.956		
SPEED/TRIALS INTERACTION	1768.500	4.	442.125	0.673	0.612
	60455.000	92.	657.119		
REST/TRIALS INTERACTION	9120.000	10.	912.000	1.390	0.186
	150884.000	230.	656.017		
SPEED/REST/ TRIALS INTERACTION	15748.500	20.	787.425	1.211	0.240
	299063.000	460.	650.137		

exercise, one rest period of three minutes duration following each of the first two exercise bouts, and three rest periods of three minutes each following the third exercise bout (see Figure 18 as example).

Table XIV shows the values obtained in the one-way analysis of variance for mean blood pressure, modified tension time index, and pulse pressure. Significant differences were found in the modified tension time index and pulse pressure, but not in the mean blood pressure.

A Tukey Test performed on the trials for modified tension time index and pulse pressure showed a significant difference occurred between those trials shown in Table XV.

The results of the Tukey Test on modified tension time index indicated that there were significant differences that occurred between the pre-exercise resting levels and all the post-exercise values. There were also some significant differences between individual values in the post-exercise resting levels. For example, the first value in each of the post-exercise sessions was significantly different from the other.

For pulse pressure, the results of the Tukey Test showed that there were statistically significant differences between the pre-exercise resting levels

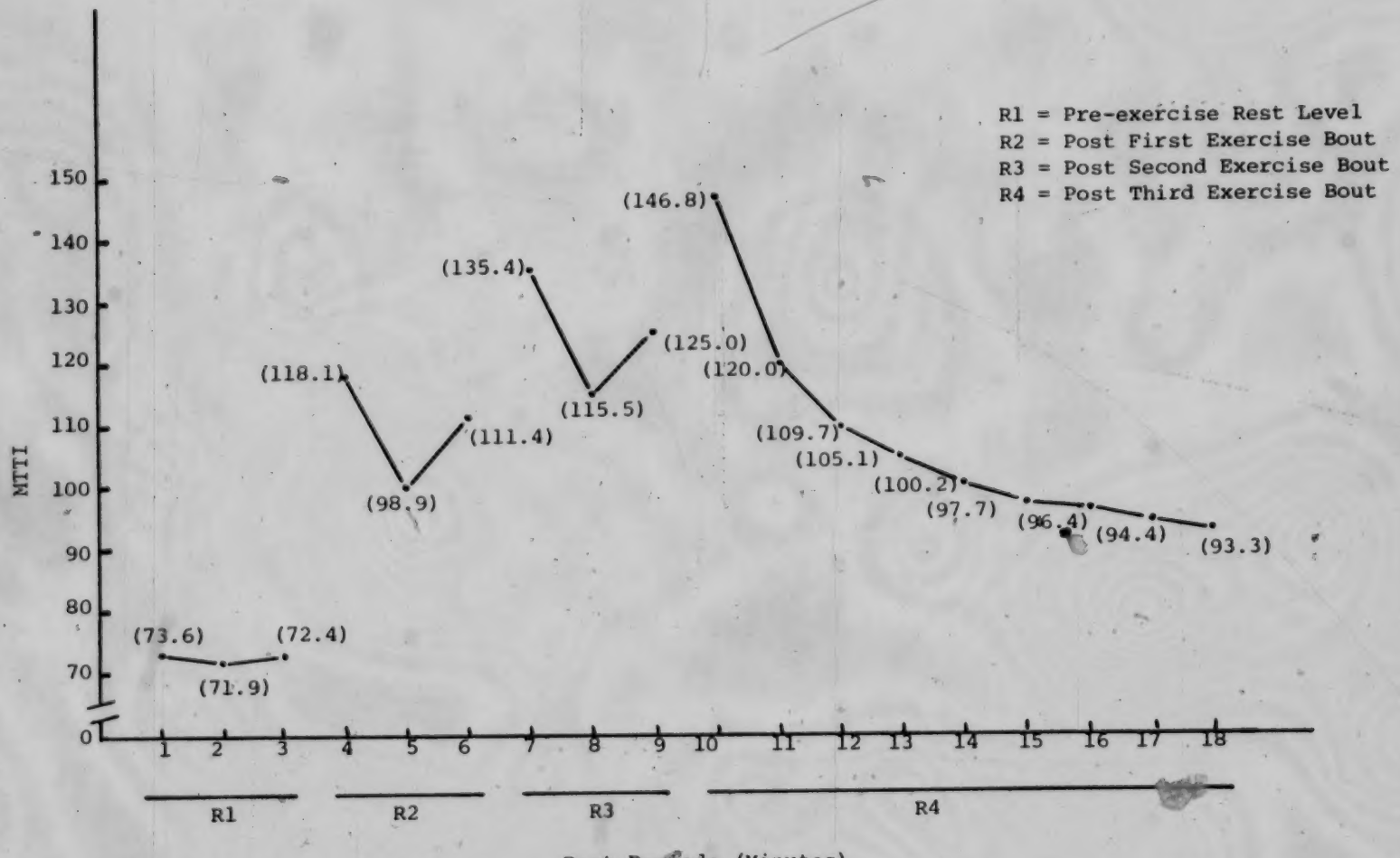

Figure 18: Modified Tension Time Index During Isokinetic Rest Periods

Table XIV

Analysis of Variance for (1) Mean Blood Pressure (2) Modified Tension Time Index, and (3) Pulse Pressure During Isokinetic Rest Periods

SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARES	F RATIO	PROBABILITY
(1) Mean Blood Pressure	83258.000	71.	1172.648		
TRIALS	6412.500	17.	377.206	1.229	0.233
(2) Modified Tension Time Index	495849.000	71.	6983.785		
TRIALS	519777.000	17.	30575.117	144.981	0.001
	254545.000	1207.	210.891		
(3) Pulse Pressure	298085.000	71.	4198.379		
TRIALS	358995.375	17.	21117.375	28.511	0.001
	893995.000	1207.	740.675		

Table XV

Significant Differences Between Trials Using Tukey Test* for Modified Tension Time Index and Pulse Pressure During Isokinetic Rest Periods

MODIFIED TENSION TIME INDEX	MODIFIED TENSION TIME INDEX	PULSE PRESSURE
73.622 - 118.101	71.861 - 100.184	37.403 - 68.597
73.622 - 98.937	71.861 - 97.676	37.403 - 66.972
73.622 - 111.398	71.861 - 96.422	37.403 - 39.958
73.622 - 135.379	81.861 - 94.434	37.403 - 71.889
73.622 - 115.495	71.861 - 93.325	37.403 - 96.681
73.622 - 124.967	72.355 - 118.101	37.403 - 72.597
73.622 - 146.796	72.355 - 98.937	36.333 - 63.397
73.622 - 119.953	72.355 - 111.398	36.833 - 66.972
73.622 - 109.665	72.355 - 135.379	36.833 - 39.958
73.622 - 105.149	72.355 - 115.495	36.833 - 71.389
73.622 - 100.184	72.355 - 124.967	36.833 - 64.417
73.622 - 97.676	72.355 - 145.796	36.833 - 96.681
73.622 - 96.422	72.355 - 119.953	36.833 - 72.639
73.622 - 94.434	72.355 - 109.665	37.028 - 63.397
73.622 - 93.325	72.355 - 105.149	37.028 - 66.972
71.861 - 118.101	72.355 - 100.184	37.028 - 89.958
71.361 - 98.937	72.355 - 97.676	37.028 - 71.889
71.361 - 111.398	72.355 - 96.422	37.028 - 96.681
71.361 - 135.379	72.355 - 94.434	37.028 - 72.639
71.861 - 115.495	72.355 - 93.325	68.597 - 96.631
71.361 - 124.967	118.101 - 98.937	66.972 - 96.681
71.361 - 146.796	118.101 - 135.379	60.375 - 39.958
71.861 - 119.953	118.101 - 146.796	60.375 - 96.681
71.861 - 109.665	118.101 - 100.184	89.958 - 62.208
71.361 - 105.149	118.101 - 97.676	89.958 - 57.278
	118.101 - 96.422	
	118.101 - 94.434	
	118.101 - 93.325	
	98.937 - 135.379	

Table XV continued

MODIFIED TENSION TIME INDEX	MODIFIED TENSION TIME INDEX	PULSE PRESSURE
98.937 - 115.495	124.967 - 96.422	89.958 - 53.528
98.937 - 124.967	124.967 - 94.434	89.958 - 50.583
98.937 - 145.796	124.967 - 93.325	89.958 - 48.056
98.937 - 119.953	146.796 - 119.953	89.958 - 45.722
111.393 - 135.379	146.796 - 109.665	89.958 - 44.222
111.398 - 145.796	146.796 - 105.149	64.417 - 96.681
111.398 - 94.434	146.796 - 100.184	96.681 - 62.208
111.398 - 93.325	146.796 - 97.671	96.681 - 57.278
135.379 - 115.495	146.796 - 96.422	96.681 - 53.528
135.379 - 119.053	146.796 - 94.434	96.681 - 50.583
135.379 - 109.665	146.796 - 93.325	96.681 - 48.056
135.379 - 105.149	119.953 - 105.149	96.681 - 45.722
135.379 - 100.184	119.953 - 100.184	96.681 - 44.222
135.379 - 98.676	119.953 - 97.676	72.639 - 44.222
135,379 - 96.422	119.953 - 96.422	
135.379 - 94.434	119.953 - 94.434	
135.379 - 93.325	119.953 - 93.325	
115.495 - 145.796	109.665 - 93.325	
115.495 - 100.184		
115.495 - 97.676		
115.495 - 96.422		
115.495 - 94.434		
115.495 - 93.325		
124.967 - 146.796		
124.967 - 109.665		
124.967 - 105.149		
124.967 - 100.184		
124.967 - 97.676		
	critical value = 14.61 @ α = .01	critical value = 27.39 @ α = .01

and all immediate post-exercise values. There were also significant differences between individual values in the post-exercise resting levels but there was no obvious pattern in these differences.

The method used for the statistical analysis of the data for heart rate during the isokinetic exercise bouts was a two-way analysis of variance on repeated measures. In the analysis, the terms speed and trials refer to the following: (1) speed - three speeds were chosen for the isokinetic apparatus - 30 degrees per second (slow), 90 degrees per second (medium), and 150 degrees per second (high), and: (2) trials refers to the order in which the selected speed of isokinetic exercise was performed during the isokinetic interval session for that particular test day.

Table XVI shows the values obtained in the two-way analysis of variance for heart rate during isokinetic exercise bouts. Significant differences were found between the different speeds, between the different trials, and significant interaction was found between speed and trials.

The data showed that the primary interaction occurred between the pre-exercise value and the first post-exercise value.

Table XVI

Analysis of Variance for Heart Rate During Isokinetic Exercise Periods

SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARES	F RATIO	PROBABILITY
	64577.000	23.	2807.696		
SPEED	4491.000	2.	2245.500	13.701	0.001
	7539.000	46.	163.891		
TRIALS	387814.500	3.	129271.500	385.002	0.001
	23168.000	69.	335.768		
SPEED/TRIALS INTERACTION	2391.000	6.	398.500	13.589	0.001
	4047.000	138.	29.326		

A Tukey Test performed on the heart rate of the three exercise bouts showed a significant difference between the first and third exercise trials (critical difference = 12.72).

The method used for the statistical analysis of the data for both systolic and diastolic blood pressure during isokinetic exercise bouts was a two-way analysis of variance on repeated measures. In the analysis, the terms speed and trials refer to the same terms as used in analysis of heart rate data for isokinetic exercise bouts.

Table XVII shows the values obtained in the two-way analysis of variance for systolic blood pressure during isokinetic exercise bouts. Significant differences were found only between the different trials and not between the different speeds.

Table XVIII shows the values obtained in the two-way analysis of variance for diastolic blood pressure during isokinetic exercise. Significant differences were found only between different trials and not between different speeds.

A Tukey Test performed on the trials for systolic and diastolic blood pressure during isokinetic exercise bouts showed that the significant difference

Table XVII

Analysis of Variance for Systolic Blood Pressure During Isokinetic Exercise Bouts

SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARES	F RATIO	PROBABILITY
	41292.000	23.	1795.304		
SPEED	22.500	2.	11.250	0.044	0.957
	11743.000	46.	255.283		
TRIALS	181329.000	3.	60443.000	402.331	0.001
	10366.000	69.	150.232		
SPEED/TRIALS INTERACTION	460.500	6.	76.750	1.100	0.366
	9629.000	138.	69.775		

Table XVIII

Analysis of Variance for Diastolic Blood Pressure During Isokinetic Exercise Periods

SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARES	F RATIO	PROBABILITY
	61934.938	23.	2692.823		
SPEED	822.375	2.	411.188	2.188	0.124
	8644.313	46.	187.920		
TRIALS	83300.625	3.	27766.875	109.479	0.001
	17500.250	69.	253.726		
SPEED/TRIALS INTERACTION	549.094	6.	91.506	2.056	0.062
	6151.500	138.	44.504		

occurred between trial one, which was the mean of the initial rest period, and thre three exercise bouts. No significant differences occurred between the three exercise bouts. This difference is illustrated in Figure 19.

The method used for the statistical analysis of the data for mean blood pressure, modified tension time index, and pulse pressure during isokinetic exercise bouts was a one-way analysis of variance on repeated measures. In the analysis, the term trial refers to the order of the different speeds of isokinetic exercise. Trials one to four occurred at thirty degrees per second; trials five to eight occurred at ninety degrees per second, and: trials nine to twelve occurred at 150 degrees per second (see Figure 20 as example). Trials one, five and nine were pre-test rest intervals to enable comparison between resting and exercise levels.

Table XIX shows the values obtained in the one-way analysis of variance for mean blood pressure, modified tension time index, and pulse pressure during isokinetic exercise. Significant differences were found in each test.

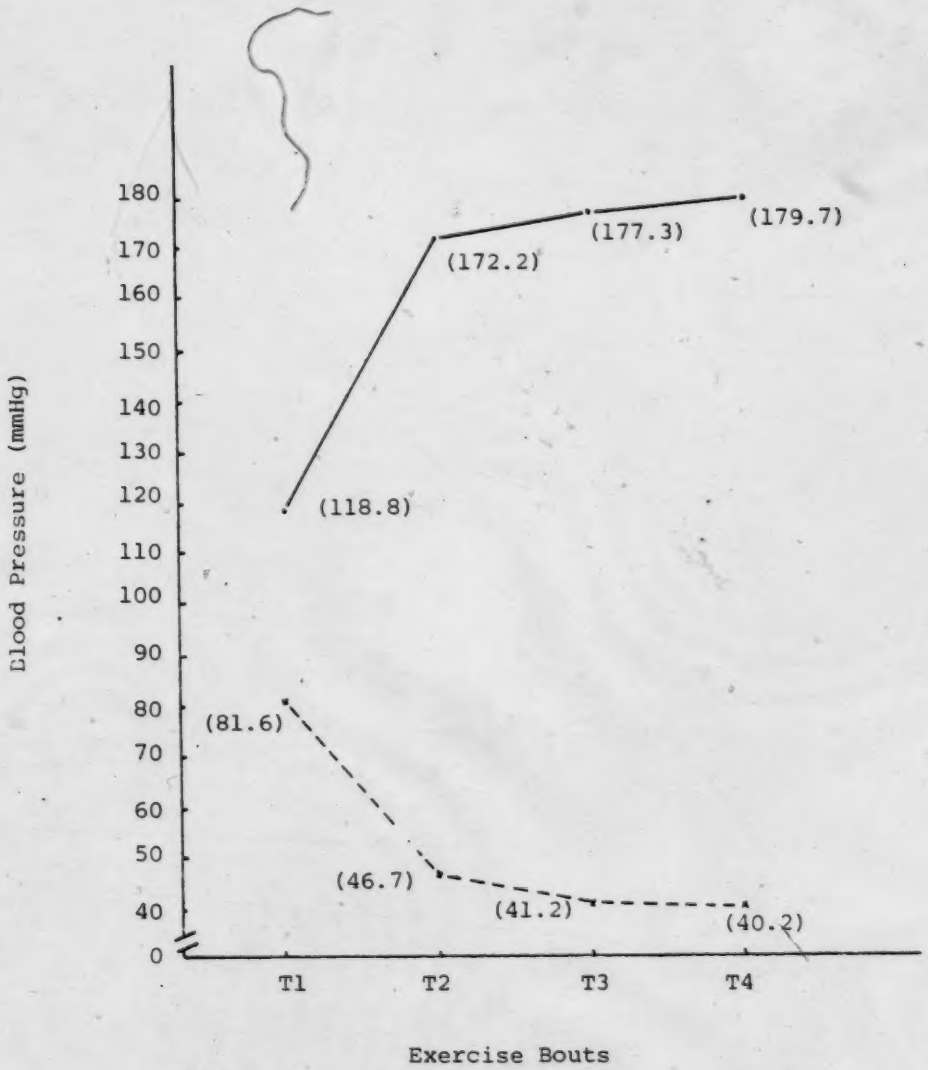

Figure 19: Systolic and Diastolic Blood Pressures During Isokinetic Exercise Bouts. (Note: T1 is Pre-exercise Rest Period)

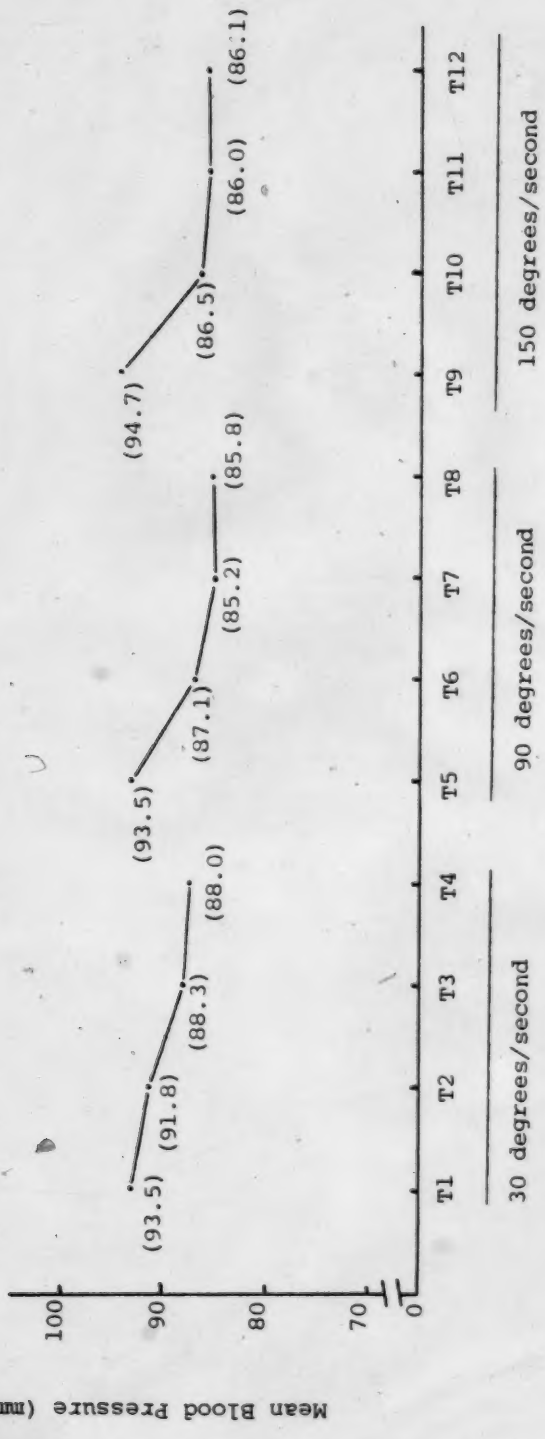

Figure 20: Mean Blood Pressure During Isokinetic Exercise Bouts

Table XIX

Analysis of Variance for (1) Mean Blood Pressure (2) Modified Tension Time Index, and (3) Pulse Pressure During Isokinetic Exercise Periods

SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARES	F RATIO	PROBABILITY
(a) Mean Blood Pressure	33324.000	23.	1448.869		
TRIALS	3204.000	11.	291.273	3.965	0.001
	18585.000	253.	73.458		
(b) Modified Tension Time Index	202786.000	23.	8816.781		
TRIALS	1887951.000	11.	171631.875	277.574	0.001
	156437.000	253.	618.328		
(c) Pulse Pressure	97469.000	23.	4237.781		
TRIALS	512283.000	11.	46571.180	194.248	0.001
	60654.000	253.	239.739		

A Tukey Test performed on the trials for mean blood pressure during isokinetic exercise bouts showed that a significant difference occurred only between trial seven and trial nine (see Figure 20).

A Tukey Test performed on the trials for the modified tension time index during isokinetic exercise bouts showed a significant difference occurred between those trials shown in Table XX. This difference is also shown in Figure 21.

The data showed that the statistically significant difference in modified tension time index occurred between the pre-exercise rest level and the three exercise levels for all three speeds of isokinetic exercise tested. There were significant differences between the first isokinetic exercise bout and the last exercise bout for all three speeds. As well, this difference was also evident between the first and the second exercise bouts for the 150 degree per second speed.

A Tukey Test performed on the trials for the pulse pressure during isokinetic exercise bouts showed a significant difference occurred between those trials shown in Table XXI. This difference is also shown in Figure 22.

Table XX

Significant Differences Between Trials Using Tukey Test* for Modified Tension Time Index During Isokinetic Exercise

TRIAL - TRIAL	TRIAL - TRIAL
74.468 - 224.091	243.578 - 282.822
74.468 - 243.578	257.984 - 73.879
74.468 - 257.984	257.984 - 70.521
74.468 - 242.117	73.879 - 242.117
74.468 - 263.856	73.879 - 263.856
84.468 - 276.780	73.879 - 276.780
74.468 - 244.430	73.879 - 244.430
74.468 - 271.701	73.879 - 271.701
74.468 - 282.822	73.879 - 282.822
224.091 - 257.984	242.117 - 276.780
224.091 - 73.879	242.117 - 70.521
224.091 - 263.856	242.117 - 271.701
224.091 - 276.780	242.117 - 282.822
224.091 - 70.521	263.856 - 70.521
224.091 - 271.701	276.780 - 70.521
224.091 - 282.822	276.780 - 244.430
243.578 - 73.879	70.521 - 244.430
243.578 - 276.780	70.521 - 271.701
243.578 - 70.521	70.521 - 282.822
243.578 - 271.701	244.430 - 271.701
	244.430 - 282.822

*critical value = 26.85 @ α = .01

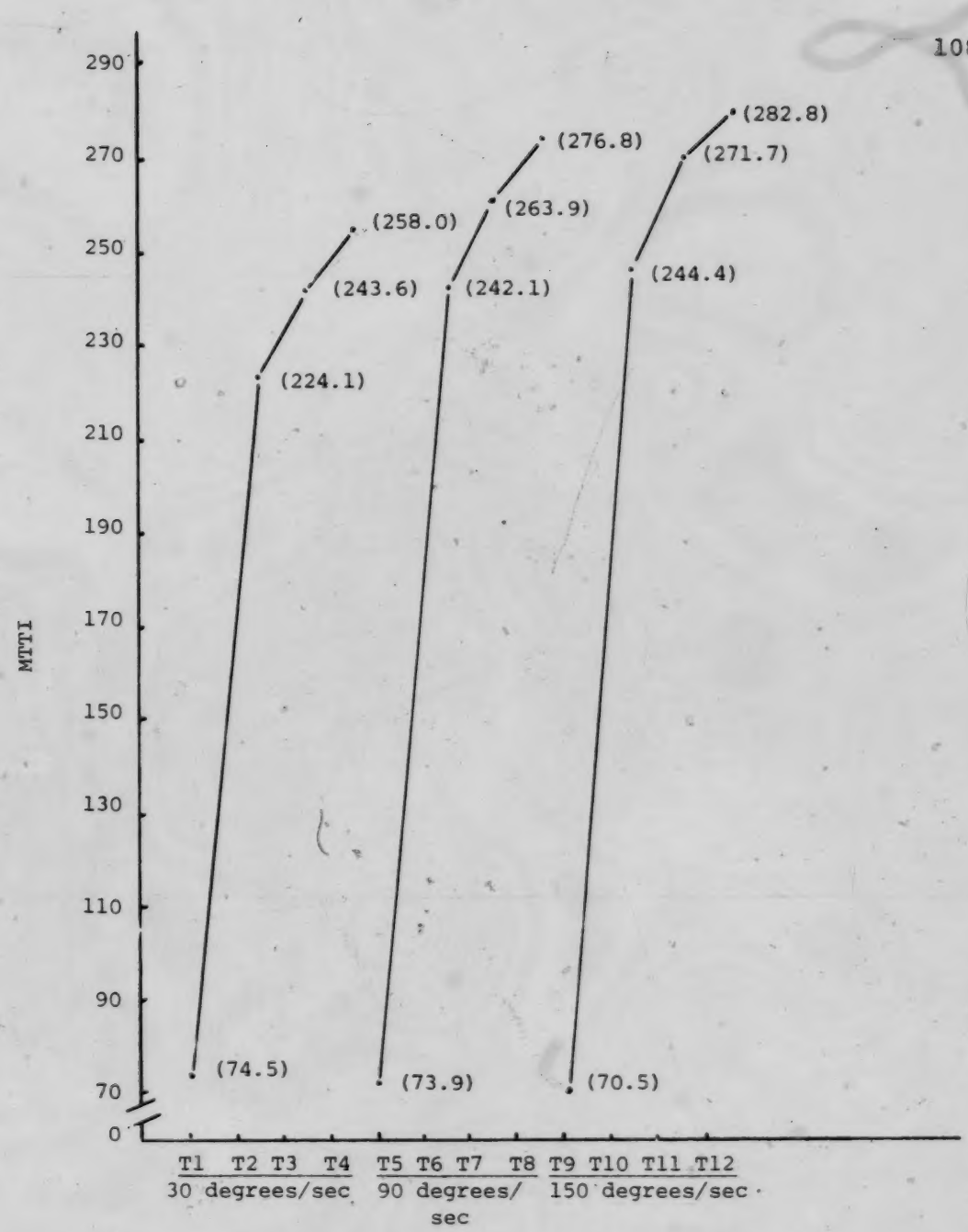

Figure 21: Modified Tension Time Index During Isokinetic Exercise Bouts

Table XXI

Significant Differences Between Trials Using Tukey Test* for Pulse Pressure During Isokinetic Exercise

TRIAL - TRIAL	TRIAL - TRIAL
38.292 - 123.417	134.250 - 37.708
38.292 - 131.167	134.250 - 35.542
38.292 - 134.250	37.708 - 125.542
38.292 - 125.542	37.708 - 137.500
38.292 - 137.500	37.708 - 142.208
38.292 - 142.208	37.708 - 126.875
38.292 - 126.875	37.708 - 139.583
38.292 - 139.583	37.708 - 141.792
38.292 - 141.792	125.542 - 35.542
123.917 - 37.708	137.500 - 35.542
123.917 - 142.408	142.208 - 35.542
123.917 - 35.542	35.542 - 126.875
123.917 - 141.792	35.542 - 139.583
131.167 - 37.708	35.542 - 141.792
131.167 - 35.542	

*critical value = 16.72 @ $\alpha = .01$

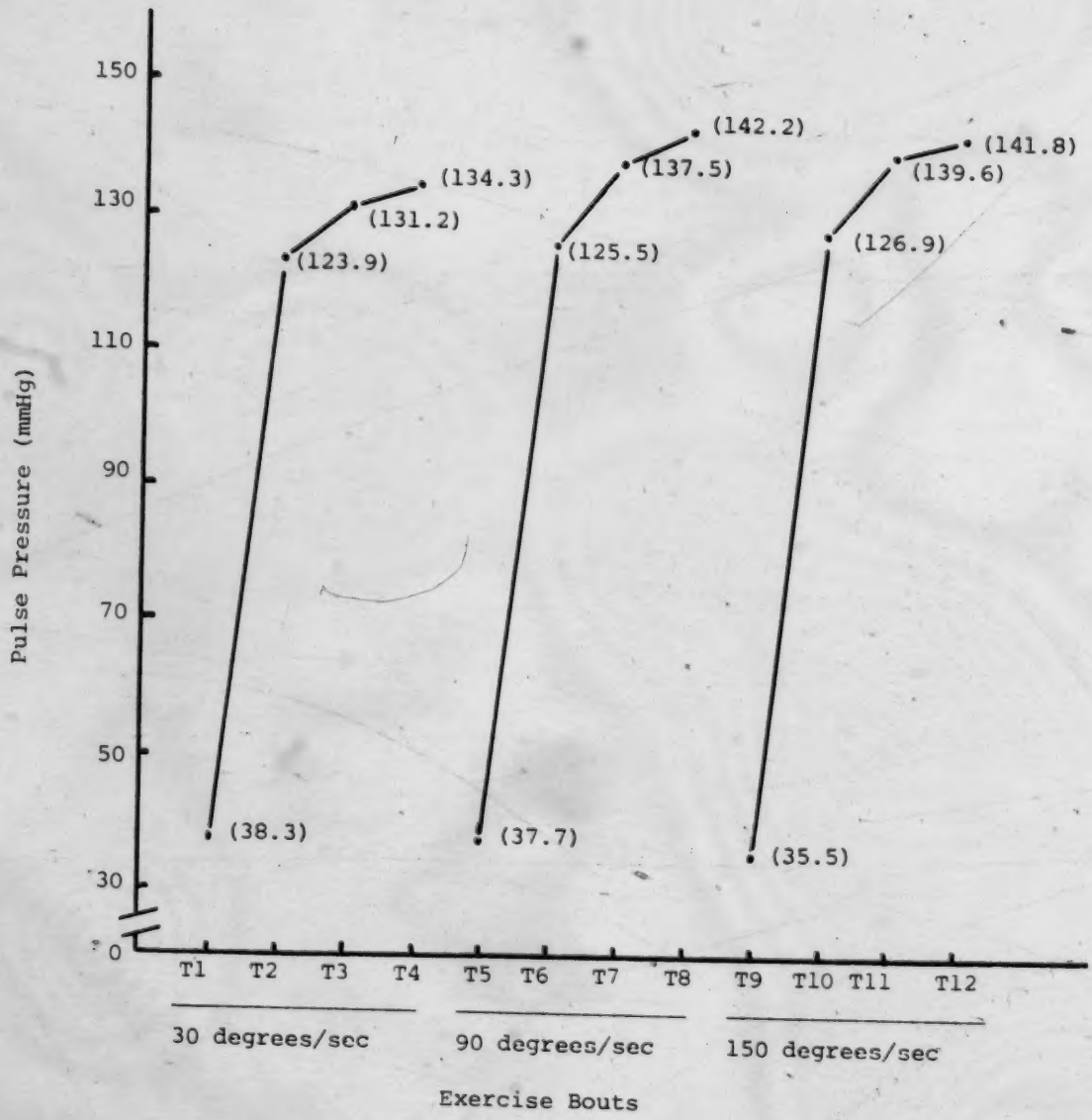

Figure 22: Pulse Pressure During Isokinetic Exercise Bouts

The data showed that there was a statistically significant difference in pulse pressure between the pre-exercise rest level and the three exercise levels for all three speeds of isokinetic exercise tested. There was no significant differences between the three exercise levels for all three speeds of isokinetic exercise tested.

Comparison of Effect of Isometric and Isokinetic Exercise on Heart Rate and Blood Pressure

In comparing the effect of isometric and isokinetic exercise on heart rate and blood pressure, only the effect of maximum voluntary contraction on heart rate and blood pressure for isometric exercise and the first isokinetic exercise bout were considered. As well, the mean blood pressure modified tension time index, and pulse pressure for maximum isometric exercise and isokinetic exercise were analyzed.

The method used for the statistical analysis of the data for heart rate during maximum isometric exercise and isokinetic exercise was a one-way analysis of variance. In the analysis, the term comheart refers to the heart rate during isokinetic exercise at thirty, ninety and 150 degrees per second, and during

maximum voluntary contraction of isometric exercise. Heart 1, 2, and 3 refer to the heart rate during isokinetic exercise at thirty degrees per second, ninety degrees per second, and 150 degrees per second, respectively. Heart 3 and 4 refer to the heart rate during maximum voluntary isometric contraction using quadriceps and hamstring muscle groups respectively.

Table XXII shows the values obtained in the one-way analysis of variance for comparison of heart rate during isometric and isokinetic exercise. The difference of the means is illustrated in Figure 23. A Scheffe Test performed on the means of the heart rate during isometric and isokinetic exercise showed that a significant difference occurred between those means shown in Table XXIII.

The data indicated there was a significant difference in heart rates between the isokinetic exercise and the isometric exercise. As well, the slow speed (thirty degrees per second) values was significantly different than the other two speeds of isokinetic exercise. Isometric quadriceps muscle group data for heart rate was also statistically different from the isometric hamstring muscle group data.

The method used for the statistical analysis of the data for systolic blood pressure during maximum isometric exercise and isokinetic exercise was a one-

Table XXII

Analysis of Variance for Comparison of Heart Rates During Isokinetic and Maximum (Isometric) Exercise

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARES	F RATIO	F PROBABILITY
BETWEEN GROUPS	4	15073.7028	3768.4255	8.867	0.0000
WITHIN GROUPS	115	48872.9453	424.9819		
TOTAL	119	63946.6445			

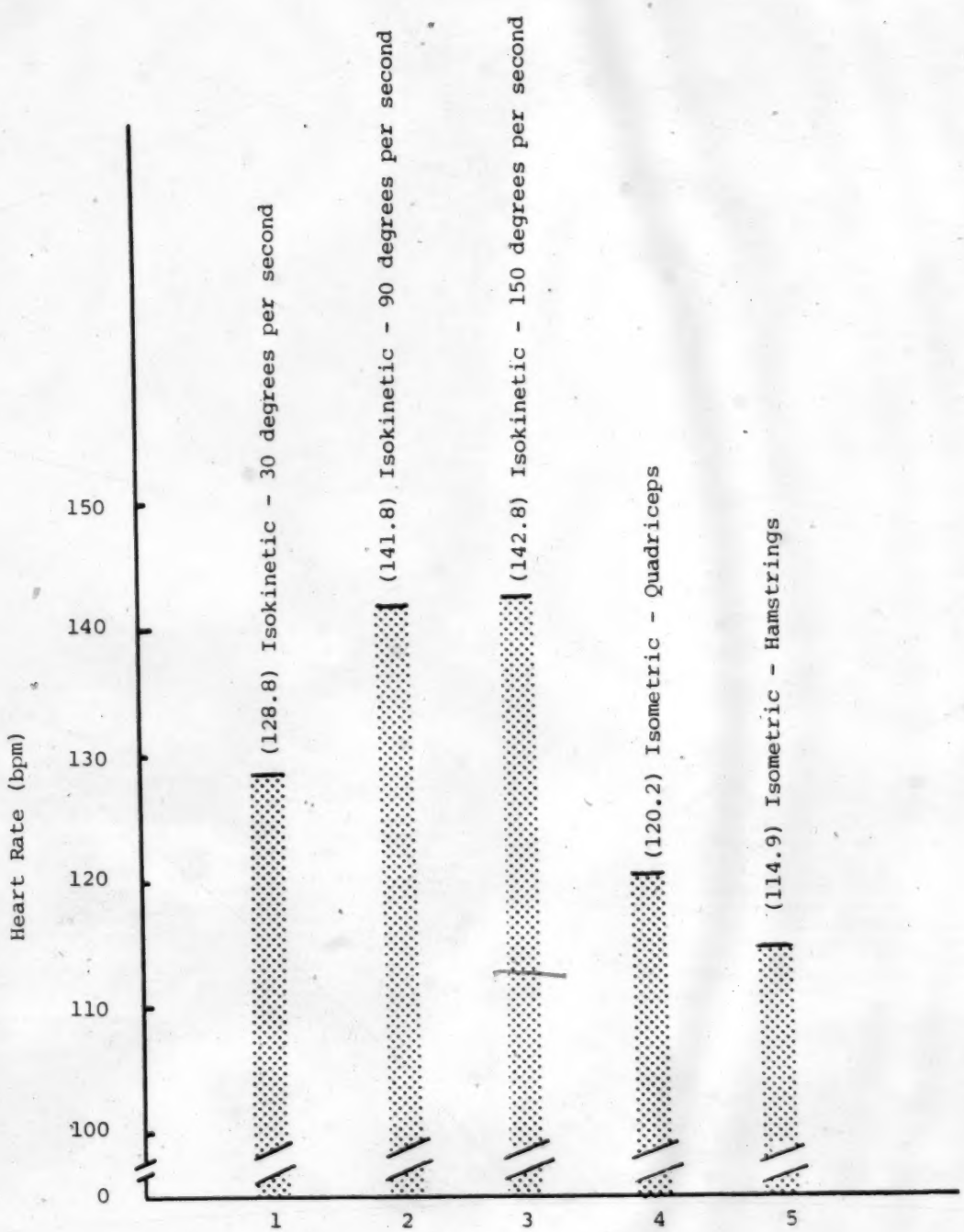

Figure 23: Maximum Heart Rate During Isokinetic and Isometric Exercise

Table XXIII

Significant Differences Between Heart Rates Using Scheffe Test* During Isokinetic and Isometric Exercise

128.792 - 141.833
128.792 - 142.792
128.792 - 120.208
128.792 - 114.917
141.833 - 120.208
141.833 - 114.917
142.792 - 120.208
142.792 - 114.417
120.208 - 114.917

*critical value = 4.43 @ $\alpha = .05$

way analysis of variance. In the analysis, the term comsystolic refers to the systolic blood pressure during isokinetic and isometric exercise. Systol 1, 2, and 3 refer to the systolic blood pressure during isokinetic exercise at thirty degrees per second, ninety degrees per second, and 150 degrees per second respectively. Systol 4 and 5 refer to the systolic blood pressure during maximum voluntary isometric contraction using quadriceps and hamstring muscle groups respectively.

Table XXIV shows the values obtained in the one-way analysis of variance for comparison of systolic blood pressure during isometric and isokinetic exercise. The difference of the means is illustrated in Figure 24.

A Scheffe Test performed on the means of the systolic blood pressure during isometric and isokinetic exercise showed that a significant difference occurred between those means shown in Table XXV.

The data for systolic blood pressure showed a statistically significant difference between isokinetic exercise and isometric exercise. There were no significant differences between the different speeds of isokinetic exercise, or between the two muscle groups performing isometric exercise.

Table XXIV

Analysis of Variance for Comparison of (1) Systolic Blood Pressure and (2) Diastolic Blood Pressure During Isokinetic and Maximum Isometric Exercise

	SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARES	F RATIO	F PROBABILITY
(1) Systolic Blood Pressure						
	BETWEEN GROUPS	4	4200.2823	1050.0706	3.395	0.115
	WITHIN GROUPS	115	35573.5039	309.3347		
	TOTAL	119	39773.7852			
(2) Diastolic Blood Pressure						
	BETWEEN GROUPS	4	136304.1758	34076.0430	120.968	0.0000
	WITHIN GROUPS	115	32394.9429	281.6951		
	TOTAL	119	168699.0625			

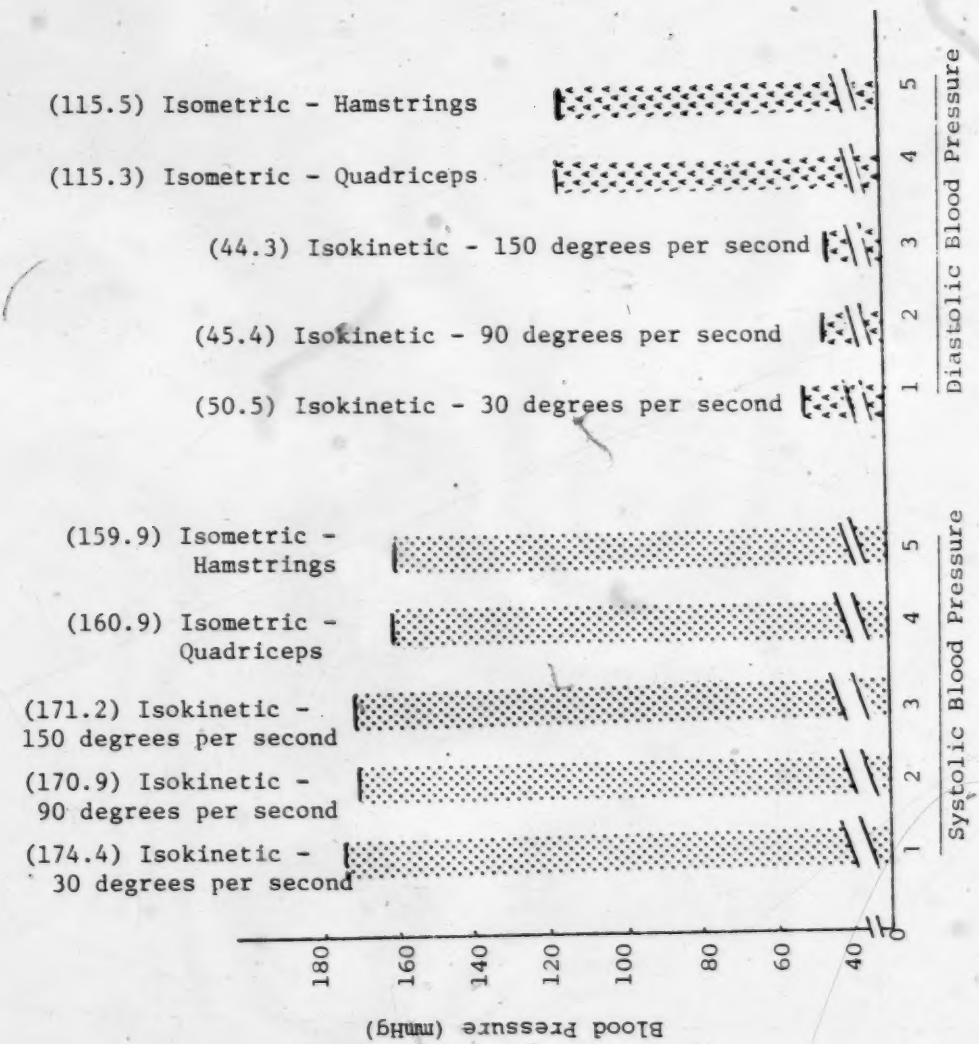
(115.5) Isometric - Hamstrings
(115.3) Isometric - Quadriceps
(44.3) Isokinetic - 150 degrees per second
(45.4) Isokinetic - 90 degrees per second
(50.5) Isokinetic - 30 degrees per second
(159.9) Isometric - Hamstrings
(160.9) Isometric - Quadriceps
(171.2) Isokinetic - 150 degrees per second
(170.9) Isokinetic - 90 degrees per second
(174.4) Isokinetic - 30 degrees per second
1 2 3 4 5
Diastolic Blood Pressure
1 2 3 4 5
Systolic Blood Pressure
0
180 160 140 120 100 80 60 40
Blood Pressure (mmHg)

Figure 24: Maximum Systolic and Diastolic Blood Pressure During Isokinetic and Maximum Isometric Exercise

Table XXV

Significant Differences Between Means Using Scheffe Test*
for (1) Systolic Blood Pressure and (2) Diastolic Blood Pressure
During Isokinetic and Isometric Exercise

(1) SYSTOLIC BLOOD PRESSURE	(2) DIASTOLIC BLOOD PRESSURE
174.5 - 160.9	50.5 - 45.4
174.5 - 159.9	50.5 - 44.3
171.2 - 160.9	50.5 -115.3
171.2 - 159.9	50.5 -115.5
170.9 - 160.9	45.4 -115.3
170.9 - 159.9	45.4 -115.5
	44.3 -115.3
	44.3 -115.5
*critical value = 4.43 @ α = .05	*critical value =4.43 @ α =.05

The method used for the statistical analysis of the data for diastolic blood pressure during maximum isometric exercise and isokinetic exercise was a one-way analysis of variance. In the analysis, the term comdiastolic refers to the diastolic blood pressure during isokinetic and isometric exercise. Diastol 1, 2, and 3 refer to the diastolic blood pressure during isokinetic exercise at thirty degrees per second, ninety degrees per second and 150 degrees per second, respectively. Diastol 4 and 5 refer to the diastolic blood pressure during maximum voluntary isometric contraction using quadriceps and hamstring muscle groups respectively.

Table XXIV shows the values obtained in the one-way analysis of variance for comparison of diastolic blood pressure during isometric and isokinetic exercise, The differences of the means is illustrated in Figure 24.

A Scheffe Test performed on the means of the diastolic blood pressure during isometric and isokinetic exercise showed that a significant difference occurred between those means shown in Table XXV.

For diastolic blood pressure, there was a statistically significant difference between the values for isometric exercise and isokinetic exercise. There

was no statistically significant difference between the two muscle groups performing isometric exercise. However, the difference was statistically significant between the slow isokinetic speed (thirty degrees per second) and the two faster isokinetic speeds.

The method used for the statistical analysis of the data for mean blood pressure during maximum isometric exercise and isokinetic exercise was a one-way analysis of variance. In the analysis, the term COMMBP refers to the mean blood pressure during isokinetic and isometric exercise. MBP1, 2, and 3 refer to the mean blood pressure during isokinetic exercise at thirty degrees per second, ninety degrees per second, and 150 degrees per second respectively. MBP4 and 5 refer to the mean blood pressure during maximum voluntary isometric contraction using quadriceps and hamstring muscle groups respectively.

Table XXVI shows the values obtained in the one-way analysis of variance for comparison of mean blood pressure during isokinetic and isometric exercise. The difference of the means is illustrated in Figure 25.

A Scheffe Test performed on the means of the mean blood pressure during isokinetic and isometric exercise showed that a significant difference occurred between those means shown in Table XXVII.

Table XXVI

Analysis of Variance for Comparison of Mean Blood Pressure During Isokinetic and Maximum Isometric Exercise

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARES	F RATIO	F PROBABILITY
BETWEEN GROUPS	4	50723.4418	12680.8594	70.702	0.0000
WITHIN GROUPS	115	20626.0930	179.3573		
TOTAL	119	71349.5000			

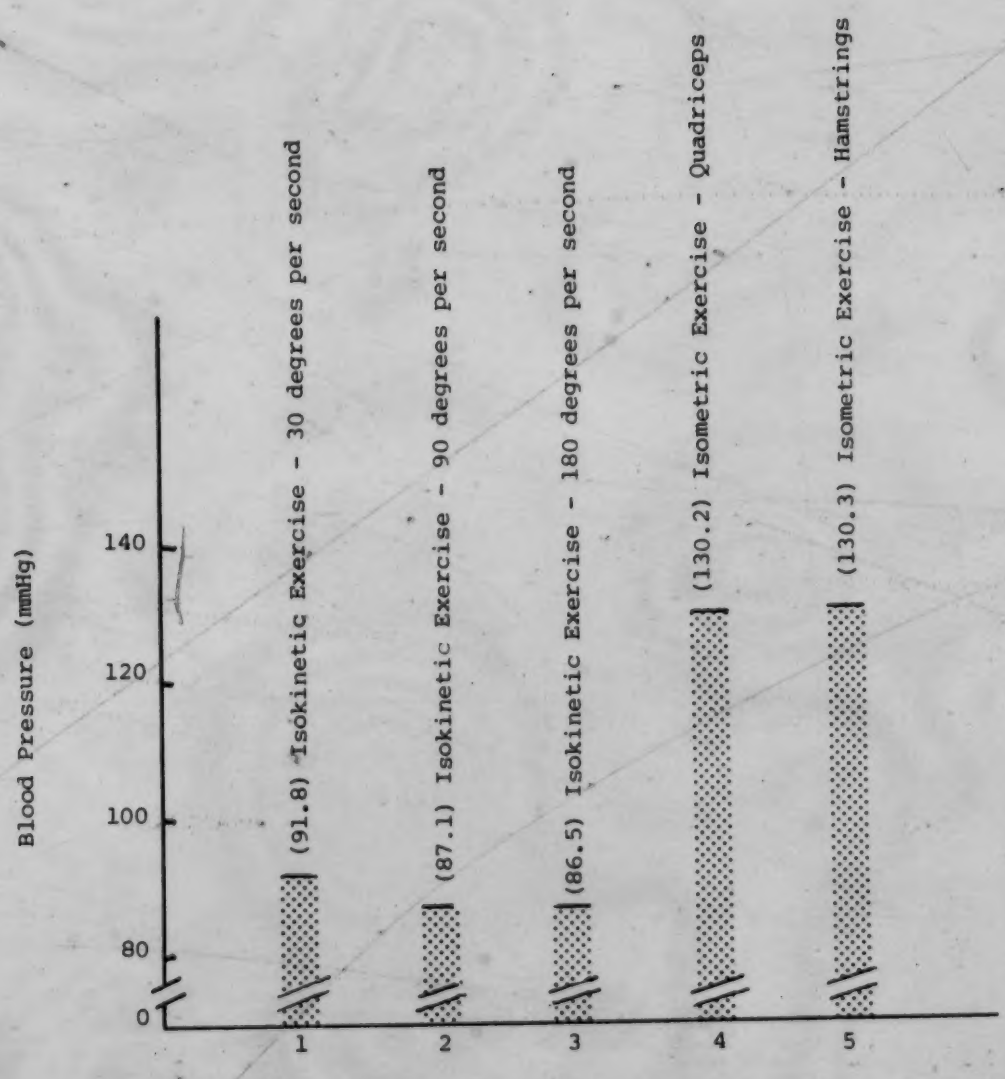

Figure 25: Mean Blood Pressure During Isokinetic and Maximum Isometric Exercise

Table XXVII

Significant Differences Between Means Using Scheffe Test*
for Mean Blood Pressure During Isokinetic and Maximum Isometric Exercise

TRIAL - TRIAL	TRIAL - TRIAL
91.8 - 87.1	87.1 - 130.2
91.8 - 86.5	87.1 - 130.3
91.8 -130.2	86.5 - 130.2
91.8 -130.3	86.5 - 130.3
*critical value = 4.43 @ α = .05	

The data for mean blood pressure showed that statistically significant differences occurred between the mean blood pressure values for isokinetic exercise and isometric exercise. As well, there was a statistically significant difference in mean blood pressure between the slow (thirty degrees per second) isokinetic speed and the two faster isokinetic speeds. There was no significant difference between the two muscle groups tested isometrically.

The method used for the statistical analysis of the data for modified tension time index during maximum isometric exercise and isokinetic exercise was a one-way analysis of variance. In the analysis, the term COMMTTI refers to the modified tension time index during isokinetic and isometric exercise. MTTI1, 2 and 3 refer to the modified tension time index during isokinetic exercise at thirty degrees per second, ninety degrees per second, and 150 degrees per second respectively. MTTI4 and 5 refer to the modified tension time index during maximum voluntary isometric contraction using quadriceps and hamstring muscle groups respectively.

Table XXVIII shows the values obtained in the one-

Table XXVIII

Analysis of Variance for Comparison of Modified Tension Time Index During Isokinetic and Maximum Isometric Exercise

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARES	F RATIO	F PROBABILITY
BETWEEN GROUPS	4	73074.5809	18268.6445	11.357	0.0000
WITHIN GROUPS	115	183994.4023	1608.6470		
TOTAL	119	258068.9375			

way analysis of variance for comparison of modified tension time index during isometric and isokinetic exercise. The difference of the means is illustrated in Figure 26.

A Scheffe Test performed on the modified tension time index during isometric and isokinetic exercise showed that a significant difference occurred between those means shown in Table XXIX.

The data for modified tension time index showed that statistically significant differences in the index occurred between isokinetic exercise and isometric exercise. As well, significant differences in the index occurred between the slow (thirty degrees per second) isokinetic speed and the two faster isokinetic speeds. There were significant differences in the index between the values obtained for the quadriceps muscle group and the hamstring muscle group during isometric exercise.

The method used for the statistical analysis of the data for pulse pressure during maximum isometric exercise and isokinetic exercise was a one-way analysis of variance. In the analysis, the term COMPP refers to the pulse pressure during isokinetic and isometric exercise. PP1, 2, and 3 refer to the pulse pressure

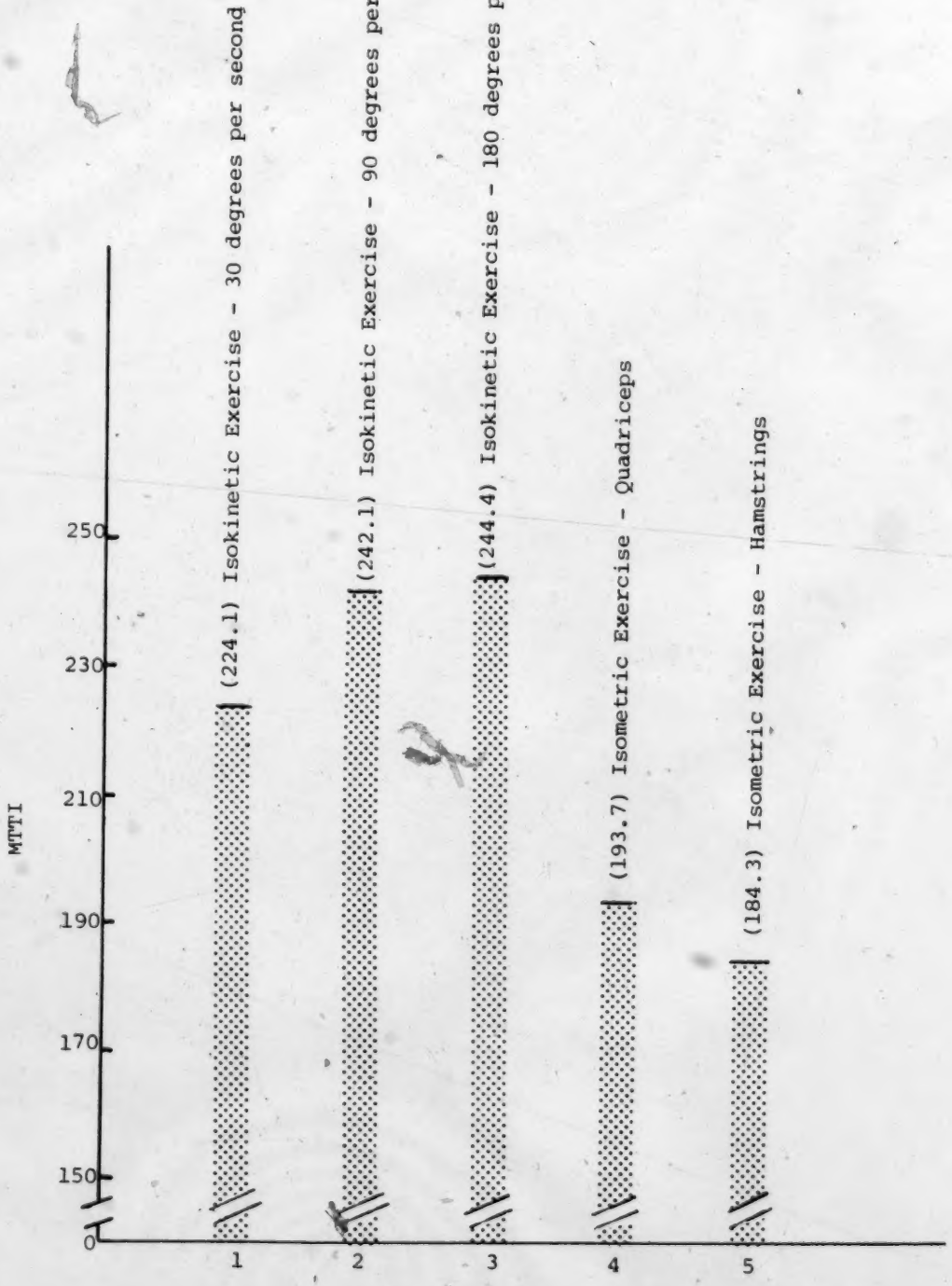

Figure 26: Modified Tension Time Index During Isokinetic and Maximum Isometric Exercise

Table XXIX

Significant Differences Between Means Using Scheffe Test* for Modified Tension Time Index During Isokinetic and Maximum Isometric Exercise

TRIAL - TRIAL	TRIAL - TRIAL
224.1 - 242.1	242.1 - 184.3
224.1 - 244.4	244.4 - 193.7
224.1 - 193.7	244.4 - 184.3
224.1 - 184.3	193.7 - 184.3
242.1 - 193.7	

*critical value = 4.43 @ α = .05

during isokinetic exercise at thirty degrees per second respectively. PP4 and 5 refer to the pulse pressure during maximum voluntary isometric contraction using quadriceps and hamstrings respectively.

Table XXX shows the values obtained in the one-way analysis of variance for comparison of pulse pressure during isometric and isokinetic exercise. The difference between the means is illustrated in Figure 27.

A Scheffe Test performed on the means of the pulse pressure during isometric and isokinetic exercise showed that a significant difference occurred between those means shown in Table XXXI. The data showed that statistically significant differences in pulse pressure occurred between isokinetic exercise and isometric exercise. There were no significant differences in pulse pressure between the three speeds of isokinetic exercise tested, nor between the two muscle groups tested isometrically.

Table XXX

Analysis of Variance for Comparison of Pulse Pressure During Isokinetic and Maximum Isometric Exercise

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARES	F RATIO	F PROBABILITY
BETWEEN GROUPS	4	186500.3514	46625.0859	93.177	0.0000
WITHIN GROUPS	115	57544.9792	500.3911		
TOTAL	119	244045.3125			

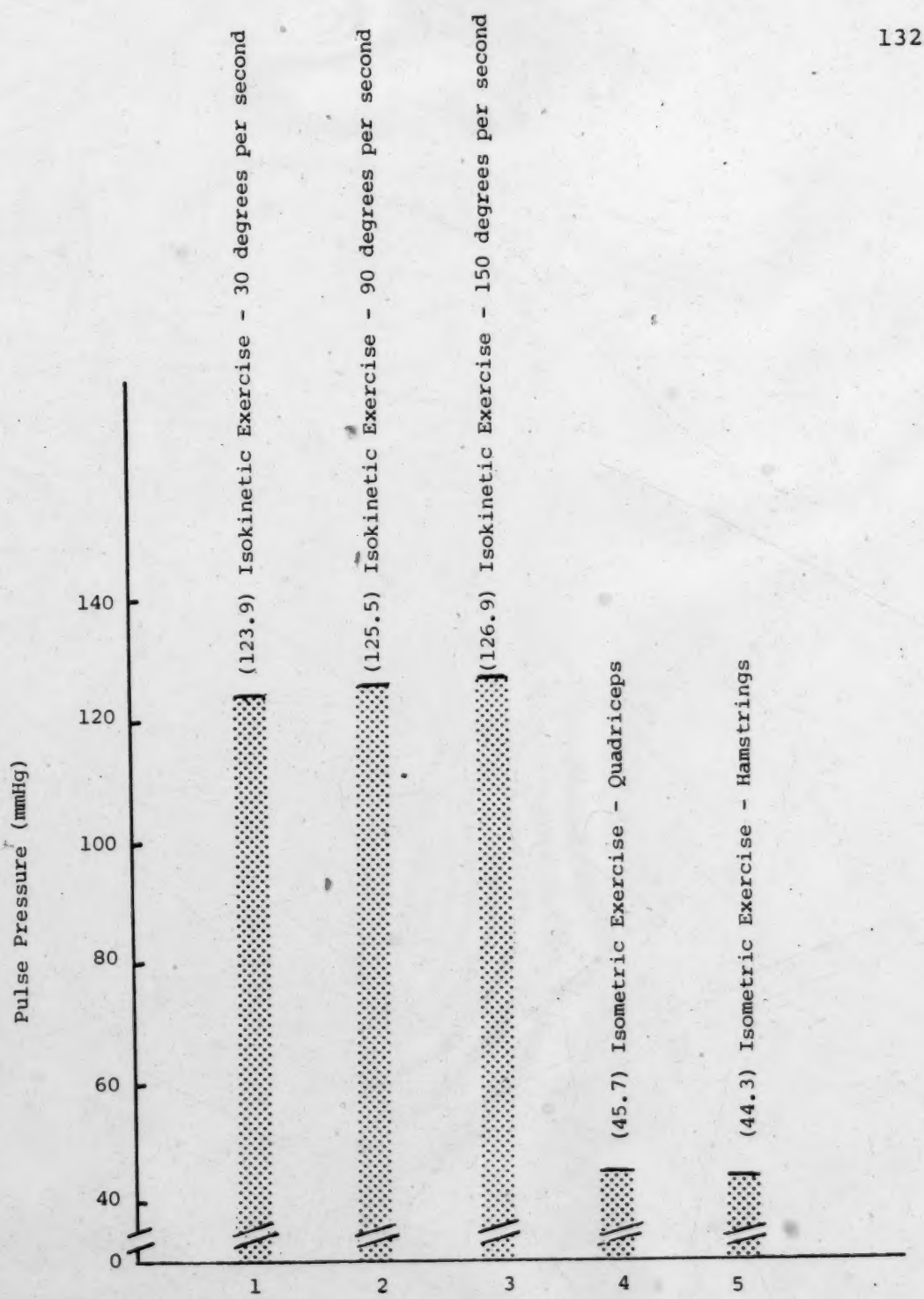

Figure 27: Pulse Pressure During Isokinetic and Maximum Isometric Exercise

Table XXXI

Significant Differences Between Means Using Scheffe Test* for Pulse Pressure During Isokinetic and Maximum Isometric Exercise

123.9 - 44.3
123.9 - 45.7
125.5 - 44.3
125.5 - 45.7
126.9 - 44.3
126.9 - 45.7

*critical value = 4.43 @ α = .05

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CHAPTER V

DISCUSSION

The purpose of the study was to determine the effect of isokinetic exercise on heart rate and blood pressure at three different speeds of movement and to determine if an isokinetic interval program had a cumulative effect on heart rate and blood pressure. In addition, the effect of isometric exercise, using quadriceps and hamstrings muscle groups, was performed to compare with the results found by previous authors. The results of the isometric and isokinetic exercises were then compared.

Effect of Isometric Exercise on Heart Rate and Blood Pressure

In both the quadriceps and hamstrings muscle groups tests, there was a statistically significant difference between trials for heart rate and a statistically significant difference in the groups/trials interaction for heart rate during the isometric rest periods. Although the interaction occurred between each of the groups, there was no definite pattern and the primary interaction was between the post-test values. These differences are due to two factors. First, following

each bout of exercise, the heart rate took several minutes to return to resting or near resting levels. Secondly, for each pre-test rest period, the subjects were told that they had one minute until they had to perform an isometric test. This information to the subject caused, in most cases, an increase in heart rate prior to the exercise due to anticipation on the part of the subject.

In the quadriceps and hamstring muscle groups, there was a statistically significant difference between the trials for systolic blood pressure and a statistically significant difference in the groups/trails interaction for systolic blood pressure during isometric rest periods. The differences shown were primarily between the pre-trial values and the post-trial values. Although the values obtained were statistically significant, they were not clinically important as they were within normal resting norms.

During the isometric rest periods, there was a statistically significant difference between the trials for mean blood pressure, modified tension time index and pulse pressure for both quadriceps and hamstring muscle groups. Again, although the values obtained were statistically significant, they were clinically unimportant. It was interesting to note, as was seen in

Figures 11, 12, and 13, that the values obtained for quadriceps muscle group were consistently higher than those obtained for the hamstrings muscle group. These differences may be due to the different size of the two muscle groups (1).

Both the quadriceps and hamstring muscle groups showed a statistically significant difference in heart rate during the isometric exercise bouts for the different percentages of muscle contraction. The increases shown were the result of the withdrawal of the vagal influence on the heart as well as hormonal influences and were consistent with the results reported by other authors (2,3,4,5,6,7,8,9,10).

During the isometric exercise bouts, both the quadriceps and hamstring muscle groups showed a statistically significant difference in systolic and diastolic blood pressure for the different percentages of muscle contraction. The increases shown were the result of increases in heart rate and consequently cardiac output.

The cardiac output was increased by the body in an attempt to overcome the constriction of the blood vessels and occlusion of the muscle vascular bed caused by the isometric contraction (3,4,5,6,7,8,9,10).

For the different percentages of muscle contrac-

tion during isometric exercise bouts, both the quadriceps and hamstring muscle groups showed a statistically significant difference in mean blood pressure, and modified tension time index for both muscle groups. A statistically significant difference in pulse pressure was also found for the hamstring muscle groups.

The mean blood pressure is an indication of the driving force required to drive the blood through the circulatory system. As the data indicated (Figure 16), the driving force required to push the blood through the circulatory system increased as the percentage of maximum voluntary contraction increased. This increase in driving force was necessary to overcome the constriction of the blood vessels and restriction of the muscle vascular bed caused by the isometric contraction (4,10).

The modified tension time index gives an indication of the oxygen consumption of the heart during exercise (11,12,13). As the data indicated (Figure 17), oxygen consumption probably increased as the percentage of maximum voluntary contraction increased. This increase was necessary to supply more oxygen to the heart when the heart was performing a higher level of activity (12, 13,14).

The pulse pressure is the difference between the systolic and diastolic blood pressure. The pulse pressure value which is normally about 40 mmHg can be increased by increased stroke volume (increase in systolic pressure and decrease in diastolic pressure) or by decreasing the capacitance of the arterial tree (15). Although the values obtained for pulse pressure were statistically significant for the hamstring muscle group, they were clinically unimportant as they fell within expected resting values.

Effect of Isokinetic Exercise on Heart Rate and Blood Pressure

During the isokinetic rest periods, there were statistically significant differences in heart rate between the three speeds of isokinetic exercise (thirty degrees per second, ninety degrees per second, and 150 degrees per second), between the rest periods, and between the trials. As well, there were statistically significant differences between the interactions of speed and rest, and rest and trials. The significant interaction between speed and rest occurred primarily between the initial rest period and the first post-exercise period. There was also an interaction between the first and second post-exercise rest periods for the medium and high speeds. The significant inter-

action between rest and trials occurred between the pre-exercise rest period and the first post-exercise rest period. There was also interaction between the second and third post-exercise periods. The changes that occurred were due to the heart rates not returning to the pre-test resting levels and the subjects were told that they had fifteen seconds to exercise. The heart rate was recorded just prior to exercise. Although the values were statistically significant they fell within expected resting heart rates and therefore, were clinically unimportant.

There were statistically significant differences in systolic blood pressure between the three speeds of isokinetic exercise, between the rest periods, and between the trials. As well, there were statistically significant differences between the interactions of speed and rest, and rest and trials. The significant interaction between speed and rest occurred primarily between the initial rest period and the first post-exercise period. The significant interaction between rest and trials occurred between the same two periods, namely, the pre-exercise period and the first post-exercise period. There were no statistically significant differences between any of the variables when looking at diastolic blood pressure. The differences

shown were primarily between the pre-trial values and the immediate post-trial values. The post-trial values at the end of the exercise session showed the blood pressure returning to near resting levels. The results do indicate that systolic pressure remains elevated during an isokinetic interval program. These values are slightly above the range one would consider normal for resting systolic blood pressures. Figure 25 also shows a drop in diastolic blood pressure during an isokinetic interval program. The differences were not statistically significant and do fall within the range one would consider normal for resting diastolic blood pressure.

Statistically significant differences during isokinetic rest periods were found for modified tension time index and pulse pressure. No significant differences were found in mean blood pressure. The values obtained show statistical significance but clinically they are unimportant as they fall within normal resting values.

During the isokinetic exercise bouts, there were statistically significant differences in heart rate between the three speeds of isokinetic exercise (thirty degrees per second, ninety degrees per second, and 150 degrees per second), between the trials, and

between the speed/trial interactions. The increases were probably due to the removal of the vagal influence on the heart and the action of hormones as was seen in isometric exercise. The continuing and increased demand for oxygen by the tissues, and the need to remove metabolites and heat would also be a factor. The heart rate increased between trials. The increased heart rate over trials is illustrated in Figure 28.

There were statistically significant differences in systolic and diastolic blood pressure between trials (Figure 19). The systolic blood pressure increased between trials and the diastolic blood pressure decreased between trials. The significant difference in blood pressure occurred between the first trial which was the pre-exercise rest period and the three exercise bouts. There was no significant difference in blood pressure between the exercise bouts. This difference was illustrated in Figure 19. The increase in systolic pressure during isokinetic exercise was due to the body's attempt to overcome the occlusion of the vascular beds within the muscle. The decrease in diastolic pressure may have been due to relaxation of one muscle group while the other muscle group contracted.

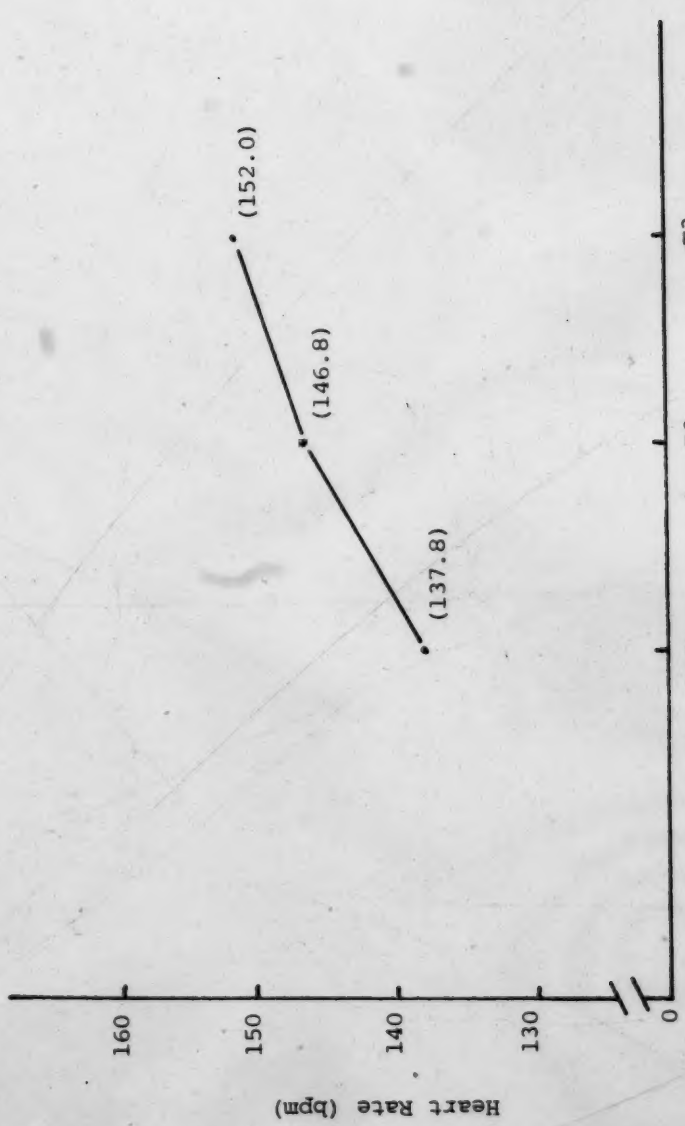

Figure 28: Increase in Heart Rate During Isokinetic Interval Exercise

The modified tension time index gives an indication of the oxygen consumption of the heart during exercise (11,12,13). As the data indicated (Figure 21 and Table 20), oxygen consumption increased with isokinetic exercise. The largest statistical difference did occur between the pre-test rest levels and the exercise levels. Trials two to four indicate isokinetic exercise at thirty degrees per second. The significant difference at this speed occurred between trial two and four indicating that with an isokinetic interval program, oxygen consumption increases with each interval of exercise.

Trials six to eight indicate isokinetic exercise at ninety degrees per second. The significant difference at this speed occurred between trial six and trial eight indicating again that oxygen consumption increases with each interval of exercise. There is also a statistically significant difference between trial two and trials seven and eight, and between trial three and trial eight indicating that as speeds of isokinetic exercise increase, oxygen consumption increases. During the isokinetic exercise, one muscle group contracted and as the contraction was maximum, the opposite or anagonist group of muscles relaxed maximally. This cyclic action could decrease the back

pressure in the arterial vessels of the relaxing muscles and in the circulatory system as a whole. The cyclic action could cause a turbulence within the vessels which could prolong the pulsations within the vessel. The pulsations could cause the sound which was heard indicating a drop in diastolic pressure. It is conceivable that these sounds may be heard even if there was no constriction on the artery (16).

Statistically significant differences during isokinetic exercise bouts were found in the mean blood pressure, modified tension time index and pulse pressure.

The mean blood pressure is an indication of the driving force required to push the blood through the circulatory system. The data indicated that the only statistically significant difference occurred between trial seven and trial nine. Although this was statistically significant, it was not clinically important as the value in trial seven occurred at ninety degrees per second while the value in trial nine was the pre-test rest value prior to exercise at 150 degrees per second (Figure 20).

Trials ten to twelve indicate isokinetic exercise at 150 degrees per second. The significant differences at this speed occurred between trial ten and trials eleven and twelve. This difference indicates that

oxygen consumption increases with each interval of isokinetic exercise. The statistically significant differences between trial two and trials eleven and twelve, between trial three and trials eleven and twelve, and between trial six and trials eleven and twelve indicate that as the speed of isokinetic exercise increases, the oxygen consumption increases.

The pulse pressure is the difference between the systolic and diastolic blood pressure (15). As the data indicated (Figure 22 and Table 21), the pulse pressure increased during isokinetic exercise. The largest statistical difference occurred between the pretest rest levels and the exercise levels. Trials two to four indicate isokinetic exercise at thirty degrees per second. Although the values between the first and third exercise bout were not statistically significant, Figure 22 does indicate that pulse pressure does increase with each exercise bout.

The data for ninety degrees per second (trial five to trial eight) and 150 degrees per second (trial nine to trial twelve) indicate similar results to isokinetic exercise at thirty degrees per second (trial one to trial four). Unlike oxygen consumption as indicated by the modified tension time index, the pulse pressure appears to level off for each bout of exercise as the

speed of isokinetic exercise increases.

Comparison of Effect of Isometric and Isokinetic Exercise on Heart Rate and Blood Pressure

Statistically significant differences in heart rate were found between isokinetic exercise and maximum isometric exercise. The data indicates that as the speed of isokinetic exercise slows, the heart rate approaches the heart rate of isometric exercise although the differences are statistically significant (Figure 23). As the speed of isokinetic exercise increases, it appears that the heart rate is levelling off and is reaching a maximum level.

When viewing systolic blood pressure, there is a statistically significant difference between isokinetic exercise and isometric exercise. This difference may be due to the contract-relax cyclical sequence of isometric exercise. There is no statistical significance between the different speeds of isokinetic exercise or between the two isometric (quadriceps/hamstrings) contractions (Figure 24). The data indicates that systolic blood pressure increases to a greater extent with isokinetic exercise than it does with isometric exercise.

There is a statistically significant difference in diastolic blood pressure between isokinetic exercise and isometric exercise. This difference, again, may be due to the contract-relax cyclical sequence of isokinetic exercise. Also, the "noise" set up within the vascular walls due to the strenuous movement during the exercise may have led to an erroneous reading which physiologically couldn't be prevented (16). This reading could lead to erroneous readings of mean blood pressure, and pulse pressure as well. There was also a statistically significant difference between the slowest isokinetic speed (thirty degrees per second) and the two faster speeds (ninety and 150 degrees per second). This difference again may have been due to the "noise" within the vascular walls.

There is a statistically significant difference in mean blood pressure, modified tension time index, and pulse pressure between isokinetic exercise and isometric exercise. The data indicates that mean blood pressure is less during isokinetic exercise indicating that the force necessary to drive the blood through the circulatory system is less with isokinetic exercise. This decrease may be due to the pumping action of the muscles as they contract and relax during isokinetic exercise.

Modified tension time index is greater during isokinetic exercise than during isometric exercise. This

higher value indicates that myocardial work and hence oxygen consumption increased more during isokinetic exercise than during isometric exercise.

Pulse pressure is greater during isokinetic exercise than during isometric exercise. This higher value is due to the increase in systolic blood pressure while the diastolic blood pressure drops during isokinetic exercise. During isometric exercise, both systolic and diastolic blood pressure rise.

The data and its statistical analysis indicates that isokinetic exercise places a greater stress on the cardiovascular system than does isometric exercise. For this reason, when one uses an isokinetic device to test or exercise a person or patient, one must be sure the subject has no known cardiovascular problems. It would appear that both isometric and isokinetic exercise place a relatively high stress on the cardiovascular system and therefore should be used with care both for exercising and testing. Further research must be carried out to determine the effects of isokinetic exercise on different age groups, different sexes, and on subjects with known cardiovascular problems.

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CHAPTER VI

SUMMARY AND CONCLUSIONS

The purpose of this study was to determine the effect of isokinetic exercise on heart rate and blood pressure at three different speeds of movement and to determine if an isokinetic interval program had a cumulative effect on heart rate and blood pressure. In addition, the quadriceps and hamstring muscle groups were tested isometrically on the Cybex II isokinetic apparatus. The effects of isometric exercise on heart rate and blood pressure were observed and compared with the results found in previous studies. A sample of twenty-four subjects was studied.

The testing procedure involved testing four increments of isometric strength on one day (maximum voluntary contraction (MVC), seventy percent MVC, thirty percent MVC, and ten percent MVC), and testing three different speeds (thirty degrees per second, ninety degrees per second, and 150 degrees per second) on the isokinetic apparatus (Cybex II isokinetic apparatus) on three consecutive days. The order of exercise was determined by a Latin Square Design.

The data was analyzed by means of one-way, two-way, and three-way analysis of variance. Significant

measurements at the .001 level of confidence were subjected to a Tukey or Scheffe Test.

Within the restrictions of the study, the null hypothesis was rejected at the .001 level of confidence for isokinetic exercise at all three speeds used - thirty degrees per second, ninety degrees per second, and 150 degrees per second. The data from the study allowed the following conclusions:

1. Heart rate increased with both isometric and isokinetic exercise. This increase in heart rate was greater for isokinetic exercise than isometric exercise.
2. Systolic blood pressure increased with both isometric and isokinetic exercise. This increase in systolic blood pressure was greater for isokinetic exercise than isometric exercise.
3. Diastolic blood pressure increased with isometric exercise and fell with isokinetic exercise.
4. Mean blood pressure was higher during isometric exercise than during isokinetic exercise.
5. Modified tension time index was higher during isokinetic exercise than during isometric exercise indicating more myocardial work and hence more oxygen consumption during isokinetic exercise.

6. Modified tension time index increased with each bout of isokinetic exercise at a specific speed indicating a cumulative effect of isokinetic exercise on oxygen consumption of the heart.
7. Modified tension time index increased with each increase in speed of isokinetic exercise indicating more myocardial work and hence an increase in oxygen consumption as the speed of isokinetic exercise increases.
8. Pulse pressure was greater during isokinetic exercise than during isometric exercise.
9. Pulse pressure increased with isokinetic exercise.

The results of this study compare the effect of two exercise modes on heart rate and blood pressure. Isometric exercise has, for some time, been known to increase the stress on the cardiovascular system which may be detrimental to people with cardiovascular problems. The data from this study concerning the second mode of exercise (isokinetic exercise) implies that this form of exercise may place an even greater stress on the cardiovascular system.

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APPENDIX A

INFORMATION TO POTENTIAL SUBJECTS FORM

Information to Potential Subjects

The testing sessions for each subject will take approximately three hours spread over four attendances. The first session will take one hour to one and a half hours and the other sessions will be of equal duration. The sessions will be on four consecutive days at the same time each day. No pre-training is required for participation in this study which is concerned with the effect of isokinetic exercise on human heart rate and blood pressure.

If you agree to participate in this study you will be asked not to eat, smoke, or drink for a period of four hours prior to your arrival in the testing laboratory. You will also be asked to perform no exercise other than walking for at least thirty minutes prior to the test.

When you arrive in the laboratory, you will be asked to sit in a special isokinetic chair and you will have straps placed around your right ankle to connect you to the isokinetic dynamometer, and straps around your right thigh and waist to stabilize you for the test. Two electrocardiogram leads will be attached to your chest by means of adhesive tape and a blood pressure cuff will be placed around your left upper arm.

During the first test session, you will be asked to perform eight isometric contractions - maximum voluntary contraction (MVC), 70% MVC, 30% MVC and 10% MVC - four for the quadriceps and four for the hamstrings - with the last three contractions being in random order. You will be asked to try and hold each contraction for up to 3 minutes.

During the subsequent three visits, you will be asked to perform an isokinetic interval training program at three randomly assigned speeds (30°/sec, 90°/sec & 150°/sec). You will be positioned in the Cybex apparatus as before and the electrocardiogram leads and blood pressure cuff will be attached as before. You will then be asked to flex and extend your knee as fast and as hard as you can for one minute, rest for three minutes, and repeat the one minute exercise, and three minutes rest cycle two more times. On each of the three visits, you will be asked to do one of the three speeds.

While doing the exercises and on completion of each exercise session, you may find that the leg feels very tired or weak. This sensation is only temporary and will disappear within two hours.

The purpose of this information is to assure that

potential subjects are informed of, and fully understand the procedures and possible after-effects to which they will be exposed if they agree to participate in the study. If you have any questions, please discuss these with the investigator before you sign the Informed Consent Form.

Should you so choose, you may end your participation in this study at any time without being required to explain your reasons for withdrawal.

All personal information given to the investigator during this study will be regarded as confidential.

APPENDIX B

CONSENT FORM FOR RESEARCH STUDY

Informed Consent Form for Research Study

I, _____, hereby give my consent to participate in a research study on the effect of isokinetic exercise on heart rate and blood pressure, the general plan of which has been explained to me.

I fully understand as it has been explained to me that by notice given to the undersigned investigator that I may withdraw from this research project any time that I may elect to do so.

_____ _____

Date Participant's Signature

I hereby certify that I have given to the above individual an explanation of the contemplated study and any possible side effects.

_____

Investigator's Signature

APPENDIX C

PERSONAL DATA FORM

TO: Each person who has agreed to participate in the study to examine the effects of isokinetic exercise on heart rate and blood pressure.

FROM: David Magee

Thank you for being willing to participate in this study.

In order that the results of the study shall be as valid as possible, I would be grateful if you would complete the details below. I assure you that these personal details will not be disclosed at any time to any third person in such a way that you could be identified from them.

PERSONAL DATA FORM

Name: Age:

Address:

Phone Number:

Please indicate by answering YES or NO in the appropriate column whether you or any member of your immediate family (parents, brothers, sisters) have, to the best of your knowledge, ever suffered from any of the following medical problems:

	SELF	FAMILY
Heart Disease		
Thrombosis		
Varicose Veins		
Swollen Ankles		
Hypertension		
Hypotension		
Respiratory Conditions		

Do you smoke? _____. If so, approximately how many per day? _____.

Are you presently taking medication for any reason?

_____.

If so, what medication and for what condition?

_____

_____

Date: _____ Signed: _____

APPENDIX D

APPOINTMENT SHEET

WEEK OF: _____

TIME	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
11:00						
12:30						
2:00						
3:30						
5:00						
6:30						
8:00						
9:30						

APPENDIX E

CONFIRMATION LETTER

TO: Volunteers who have agreed to participate in the study to examine the effects of isokinetic exercise on heart rate and blood pressure.

Dear :

Thank you for being willing to act as a subject in this study. It has been possible to arrange your test appointments at the times suggested by you.

Your appointments will be on:

_____ at _____

_____ at _____

_____ at _____

_____ at _____

I would be grateful if you would let me know in advance if, for any reason you are unable to attend for this appointment. You may get in touch with me by leaving a message in my mail box at Corbett Hall or by telephoning 434-6547 or 439-4181 and leaving a message.

You should feel free to invite one colleague to accompany you to the test sessions if you so choose. One of your friends who is not a subject may be glad of the opportunity to see what is being done.

You are reminded that you should not eat, drink, or smoke for a period of four hours prior to the start of your test session.

Please wear a P.E. kit for the test sessions.

I look forward to seeing you.

Yours sincerely,

David J. Magee

APPENDIX F

APPOINTMENT REMINDER FORM

TO: Volunteers who have agreed to participate in the study to examine the effects of isokinetic exercise on heart rate and blood pressure.

Dear :

This notice is just a reminder that you are scheduled for testing next week.

Your appointments as arranged were:

_____ at _____

_____ at _____

_____ at _____

_____ at _____

You are reminded that you should not eat, drink, or smoke for a period of four hours prior to the start of your test session.

Please wear a P.E. kit for the test sessions.

I look forward to seeing you.

Yours sincerely,

David J. Magee

APPENDIX G

CONVERSION CHART

Maximum Voluntary Contraction (MVC) to Percentage Maximum Voluntary Contraction

MVC(ft.lb)	70% MVC(ft.lb)	30% MVC(ft.lb)	10% MVC(ft.lb)
11	8	3	1
12	8	4	1
13	9	4	1
14	10	4	1
15	11	5	2
16	11	5	2
17	12	5	2
18	13	5	2
19	13	6	2
20	14	6	2
21	15	6	2
22	15	7	2
23	16	7	2
24	17	7	2
25	18	8	3
26	18	8	3
27	19	8	3
28	20	8	3
29	20	9	3
30	21	9	3
31	22	9	3
32	22	10	3
33	23	10	3
34	24	10	3
35	25	11	4
36	25	11	4

MVC(ft.lb)	70% MVC(ft.lb)	30% MVC(ft.lb)	10% MVC(ft.lb)
37	26	11	4
38	27	11	4
39	27	12	4
40	28	12	4
41	29	12	4
42	29	13	4
43	30	13	4
44	31	13	4
45	32	14	5
46	32	14	5
47	33	14	5
48	34	14	5
49	34	15	5
50	35	15	5
51	36	15	5
52	36	16	5
53	37	16	5
54	38	16	5
55	39	17	6
56	39	17	6
57	40	17	6
58	41	17	6
59	41	18	6
60	42	18	6
61	43	18	6
62	43	19	6
63	44	19	6

MVC(ft.lb)	70% MVC(ft.lb)	30% MVC(ft.lb)	10% MVC(ft.lb)
64	45	19	6
65	46	20	7
66	46	20	7
67	47	20	7
68	48	20	7
69	48	21	7
70	49	21	7
71	50	21	7
72	50	22	7
73	51	22	7
74	52	22	7
75	53	23	8
76	53	23	8
77	54	23	8
78	55	23	8
79	55	24	8
80	56	24	8
81	57	24	8
82	57	25	8
83	58	25	8
84	59	25	8
85	60	26	9
86	60	26	9
87	61	26	9
88	62	26	9
89	62	27	9
90	63	27	9

MVC(ft.lb)	70% MVC(ft.lb)	30% MVC(ft.lb)	10% MVC(ft.lb)
91	64	27	9
92	64	28	9
93	65	28	9
94	66	28	9
95	67	29	10
96	67	29	10
97	68	29	10
98	69	29	10
99	69	30	10
100	70	30	10
101	71	30	10
102	71	31	10
103	72	31	10
104	73	31	11
105	74	32	11
106	74	32	11
107	75	32	11
108	76	32	11
109	76	33	11
110	77	33	11
111	78	33	11
112	78	34	11
113	79	34	11
114	80	34	11
115	81	35	12
116	81	35	12

MVC(ft.lb)	70% MVC(ft.lb)	30% MVC(ft.lb)	10% MVC(ft.lb)
117	82	35	12
118	83	35	12
119	83	36	12
120	84	36	12
121	85	36	12
122	85	37	12
123	86	37	12
124	87	37	12
125	88	38	13
126	88	38	13
127	89	38	13
128	90	38	13
129	90	39	13
130	91	39	13
131	92	39	13
132	92	40	13
133	93	40	13
134	94	40	13
135	95	41	14
136	95	41	14
137	96	41	14
138	97	41	14
139	97	42	14
140	98	42	14

MVC(ft.lb)	70% MVC(ft.lb)	30% MVC(ft.lb)	10% MVC(ft.lb)
141	99	42	14
142	99	43	14
143	100	43	14
144	101	43	14
145	102	44	15
146	102	44	15
147	103	44	15
148	104	44	15
149	104	45	15
150	105	45	15
151	106	45	15
152	106	46	15
153	107	46	15
154	108	45	15
155	109	47	16
156	109	47	16
157	110	47	16
158	111	47	16
159	111	48	16
160	112	48	16
161	113	48	16
162	113	49	16
163	114	49	16
164	115	49	16
165	116	50	17
166	116	50	17
167	117	50	17

MVC(ft.lb)	70% MVC(ft.lb)	30% MVC(ft.lb)	10% MVC(ft.lb)
168	118	50	17
169	118	51	17
170	119	51	17
171	120	51	17
172	120	52	17
173	121	52	17
174	122	52	17
175	123	53	18
176	123	53	18
177	124	53	18
178	125	53	18
179	125	54	18
180	126	54	18
181	127	54	18
182	127	55	18
183	128	55	18
184	129	55	18
195	130	56	19
186	130	56	19
187	131	56	19
188	132	56	19
189	132	57	19
190	133	57	19
101	134	57	19
192	134	58	19
193	135	58	19

MVC(ft.lb)	70% MVC(ft.lb)	30% MVC(ft.lb)	10% MVC(ft.lb)
194	136	58	19
195	137	59	20
196	137	59	20
197	138	59	20
198	139	59	20
199	139	60	20
200	140	60	20
201	141	60	20
202	141	61	20
203	142	61	20
204	143	61	20
205	144	62	21
206	144	62	21
207	145	62	21
208	146	62	21
209	146	63	21
210	147	63	21
211	148	63	21
212	148	64	21
213	149	64	21
214	150	64	21
215	151	65	22
216	151	65	22
217	152	65	22
218	153	65	22
219	153	66	22
220	154	66	22

MVC(ft.lb)	70% MVC(ft.lb)	30% MVC(ft.lb)	10% MVC(ft.lb)
221	155	66	22
222	155	67	22
223	156	67	22
224	157	67	22
225	158	68	23
226	158	68	23
227	159	68	23
228	160	68	23
229	160	69	23
230	161	69	23
231	162	69	23
232	162	70	23
233	163	70	23
234	164	70	23
235	165	71	24
236	165	71	24
237	166	71	24
238	167	71	24
239	167	72	24
240	168	72	24
241	169	72	24
242	169	73	24
243	170	73	24
244	171	73	24
245	172	74	25
246	172	74	25
247	173	74	25

MVC(ft.lb)	70% MVC(ft.lb)	30% MVC(ft.lb)	10% MVC(ft.lb)
248	174	74	25
249	174	75	25
250	175	75	25
251	176	75	25
252	176	76	25
253	177	76	25
254	178	76	25
255	179	77	26
256	179	77	26
257	180	77	26
258	181	77	26
259	181	78	26
260	172	78	26
261	173	78	26
262	173	79	26
263	174	79	26
264	185	79	26
265	186	80	27
266	186	80	27
267	187	80	27
268	188	80	27
269	188	81	27
270	189	81	27
271	190	81	27
272	190	82	27
273	191	82	27

MVC(ft.lb)	70% MVC(ft.lb)	30% MVC(ft.lb)	10% MVC(ft.lb)
274	192	82	27
275	193	83	28
276	193	83	28
277	194	83	28
278	195	83	28
279	195	84	28
280	196	84	28
281	197	84	28
282	197	85	28
283	198	85	28
284	199	85	28
285	200	86	29
286	200	86	29
287	201	86	29
288	202	86	29
289	202	87	29
290	203	87	29
291	204	87	29
292	204	88	29
293	205	88	29
294	206	88	29
295	207	89	30
296	207	89	30
297	209	89	30
298	209	89	30
299	209	90	30
300	210	90	30

APPENDIX H

CALIBRATION CHART - ISOKINETIC APPARATUS

CYBEX CALIBRATION

RECORDER SCALE SELECTOR	LEVER ARM Inches*	WEIGHT Pounds	CALIB. TORQUE INPUT Foot Pounds	GRAPH RECORDING PEAK
360	30	70	180	5 Major Divisions
180	31	32.5	90	5 Major Divisions
30	33	5	20	20 Major Divisions

CALIBRATION POINTS (mid-scale)

360 Scale *30" 70 lbs on arm yields 180 ft lbs (5 Major Divisions)

180 Scale *31" 32.5 lbs on arm yields 90 ft lbs (5 Major Divisions)

30 Scale *33" 5 lbs on arm yields 20 ft lbs(20 Major Divisions)

*Distance from center of CYBEX input shaft to center of T tube (lever arm length).

Procedure:

1. Select Recorder Range scale (0-30, 0-180 or 0-360).
2. With Speed Selector ON at 5 RPM and Recorder ON but no torque applied to input shaft:
   a) Select #4 position on Damping control.
   b) Select slow chart speed (2mm/sec).
   c) Align stylus with baseline of chart paper grid using Zero Adjust control.
   d) Check to see baseline does not shift when range scale is changed. Plus or minus small division of change on the 30 scale is acceptable. Baseline shift can be corrected by adjusting with a small screwdriver the potentiometer behind the cap marked ZERO on the front vertical panel of the recorder case.
3. Attach proper amount of disc weights to T bar as per above calibration. Check accuracy of weights first as a 25 lb. weight may be off as much as 1/2 lb. from its indicated value. A 2 1/2 lb. weight may be off 1/4 lb. Use correct weight value.

4. Dynamic calibration is done by manually lifting weighted T bar to vertical position above dynamometer, then allowing it to swing down until weights contact the floor. As weighted arm passes the horizontal, it is applying the specified torque. The graph recording will show this value as the maximum point on the curve. If this point is above or below the correct torque value, adjust the recorder and make it read the correct value by turning the appropriate (30, 180, 360) potentiometer behind the plug on the front case of the recorder using a small screwdriver. Turning the pot clockwise will decrease the reading and counterclockwise will increase it.

APPENDIX I

ISOMETRIC LABORATORY WORK SHEET

ISOMETRIC LABORATORY WORKSHEET

SUBJECT NUMBER: _____

HEART RATE (bpm)	5 Minute Rest Period	MVC 1 Minute	5 Minute Rest Period	% age MVC 1 Minute	5 Minute Rest Period	% age MVC 1 Minute	5 Minute Rest Period	% age MVC 1 Minute	5 Minute Rest Period
QUADRICEPS	1	1	1	1	1	1	1	1	1
	2		2		2		2		2
	3		3		3		3		3
	4		4		4		4		4
	5		5		5		5		5
HAMSTRINGS	1	1	1	1	1	1	1	1	1
	2		2		2		2		2
	3		3		3		3		3
	4		4		4		4		4
	5		5		5		5		5
Blood Pressure(mmHg)									
QUADRICEPS	1	1	1	1	1	1	1	1	1
	2		2		2		2		2
	3		3		3		3		3
	4		4		4		4		4
	5		5		5		5		5
HAMSTRINGS	1	1	1	1	1	1	1	1	1
	2		2		2		2		2
	3		3		3		3		3
	4		4		4		4		4
	5		5		5		5		5

APPENDIX J

ISOKINETIC LABORATORY WORK SHEET

ISOKINETIC LABORATORY WORKSHEET

Subject Number: _____

		5 Minute Rest Period	1 Minute Exercise	3 Minute Rest Period	1 Minute Exercise	3 Minute Rest Period	1 Minute Exercise	Rest Period (Return to Resting Value)	
SESSION ONE	Heart Rate (bpm)	1	1	1	1	1	1	1	6
		2		2		2		2	7
		3		3		3		3	8
		4						4	9
SPEED:		5						5	10
	Blood Pressure (mmHg)	1	1	1	1	1	1	1	6
		2		2		2		2	7
		3		3		3		3	8
		4						4	9
		5						5	10
SESSION TWO	Heart Rate (bpm)	1	1	1	1	1	1	1	6
		2		2		2		2	7
		3		3		3		3	8
		4						4	9
SPEED:		5						5	10
	Blood Pressure (mmHg)	1	1	1	1	1	1	1	6
		2		2		2		2	7
		3		3		3		3	8
		4						4	9
		5						5	10
SESSION THREE	Heart Rate (bpm)	1	1	1	1	1	1	1	6
		2		2		2		2	7
		3		3		3		3	8
		4						4	9
SPEED:		5						5	10
	Blood Pressure (mmHg)	1	1	1	1	1	1	1	6
		2		2		2		2	7
		3		3		3		3	8
		4						4	9
		5						5	10

APPENDIX K

LATIN SQUARE DESIGN

FOR

PERCENTAGE MAXIMUM VOLUNTARY CONTRACTIONS

AND

SPEEDS OF ISOKINETIC EXERCISE

70% MVC	30% MVC	10% MVC
A	B	C
B	C	A
C	A	B
A	B	C
B	C	A
C	A	B
etc		

150 degrees/second	90 degrees/second	30 degrees/second
A	B	C
B	C	A
C	A	B
A	B	C
B	C	A
C	A	B
etc		

(from B.J. Winer, Statistical Principles in Experimental Design, 2nd edition, 1971, pg. 685)

APPENDIX L

Raw Data

INDEX

1. Raw data for isokinetic rest-heart rate
Read 062; 058; 060; 075; etc.

2. Raw data for isokinetic rest-blood pressure
Read 130/088 (systolic/diastolic); 130/086; 130/090; etc.

3. Raw data for isokinetic exercise-heart rate
Read 060; 104; 102; 100; 065; etc.

4. Raw data for isokinetic exercise-blood pressure
Read 130/88 (systolic/diastolic); 210/66; 200/72; etc.

5. Raw data for Isometric rest-quadriceps-heart rate
Read 070; 087; 078; 080

6. Raw data for isometric rest-quadriceps-blood pressure
Read 122/082 (systolic/diastolic); 122/084; 120/084; etc.

7. Raw data for isometric rest-hamstrongs-heart rate
Read 077; 080; 070; 082; 077

8. Raw data for isometric rest-hamstrings-blood pressure
Read 120/084 (systolic/diastolic); 116/084; 118/084; etc.

9. Raw data for isometric exercise-quadriceps-heart rate
Read 110; 087; 078; 090

10. Raw data for isometric exercise-quadriceps-blood pressure
Read 140/110 (systolic/diastolic); 130/100; 120/88; etc.

11. Raw data for isometric exercise-hamstrings-heart rate
Read 100; 096; 085; 085.

12. Raw data for isometric exercise-hamstrings-blood pressure
Read 140/110 (systolic/diastolic); 142/110; etc.

13. Raw data for isokinetic rest
(a) mean blood pressure (V28-V36)
(b) modified tension time index (V37-V45)
(c) pulse pressure (V46-V54)

14. Raw data for isokinetic exercise
    (a) mean blood pressure (V37-V48)
    (b) modified tension time index (V49-V60)
    (c) pulse pressure (V61-V72)

15. Raw data for isometric rest-quadriceps
    (a) mean blood pressure (V16-V20)
    (b) modified t-nsion time index (V21-V25)
    (c) pulse pressure (V26-V30)

16. Raw data for isometric rest-hamstrings
    (a) mean blood pressure (V16-V20)
    (b) modified tension time index (V21-V25)
    (c) pulse pressure (V26-V30)

17. Raw data for isometric exercise-quadriceps
    (a) mean blood pressure (V13-V16)
    (b) modified tension time index (V17-V20)
    (c) pulse pressure (V21-V24)

18. Raw data for isometric exercise-hamstrings
    (a) mean blood pressure (V13-V16)
    (b) modified tension time index (V17-V20)
    (c) pulse pressure (V21-V24)

19. Raw data for comparison of isokinetic and isometric exercise-heart rate

20. Raw data for comparison of isokinetic and isometric exercise- systolic blood pressure

21. Raw data for comparison of isokinetic and isometric exercise- diastolic blood pressure

22. Raw data for comparison of isokinetic and isometric exercise- mean blood pressure

23. Raw data for comparison of isokinetic and isometric exercise- modified tension time index

24. Raw data for comparison of isokinetic and isometric exercise - pulse pressure

1. Raw data for isokinetic rest-heart rate
Read 062; 058; 060; 075; etc.

```
 1  062058060075063065073065070070060067065068061059062062
 2  062065067085075075083068075083075070070078073065060072
 3  060063065075065070078073072080074068074072074070070076
 4  065073067075062110102093100096075090080090085080090090
 5  058060060060060095060063095090083068085070080080073080
 6  064060060083075095115087115095097092090085090076087095
 7  057055055070065080074065073070060065057062061070058060
 8  054048058070065063075072072072070073060062065060059062
 9  052055052075062070070070085097068062070070068060065062
10  050055055070058083065067082073056060065054053061062058
11  044035055080080095105090110100087078076075075074076073
12  057043044062061054073068078087073070072065062063070068
13  054058058073070060098060075076072073063068065065063066
14  053057053083072087078069078086075097075078068070065075
15  055062050083068075085075088092094090083075065072063070
16  056055055065055065070063065072065070070070067072073065
17  063058070075075075095077090093080080083080080078080078
18  055060050082072080090095100103093085084085083085085082
19  085090073088070070075075110077090080077075078080073074
20  055055080080065107070087112075068070075078082068085085
21  083070074060085085095098118090090084085086087086084085
22  047065063068070075077060057075070064065063065075068058
23  075073075090093102112095110108100092087087090083085085
24  055063063085072090092087100100080085080078070073075080
25  070070070080070087087076088090078070080075075085085085
26  067080070090075075075075085083075090075075085085078086
27  070073070080075078088080085078080085085095085090080081
28  071057062075060065093064090100075075080075070070065065
29  062057060085083088101095095096094086077074073078075077
30  066066053087078080093087090096085078076080075080076073
31  058066056067065090072080075090085075078080080082083084
32  045047060078065090075075095085085083087083078083083080
33  042044045068082090089080088100090090080078083080080080
34  086082086098098090095090090103090095095088100100101085
35  065070075097085090100080097100085087087092085085095090
36  090085078100095095112108106116100105100103095095095087
37  063065060058060065063065070067062068065070065066070065
38  082080080090080080070085090090095080090080087085077070
39  062066066078058070077070085084083072087067070070072080
40  045048047053047070063071070065055050060055055060055055
41  047045055048060055060068073082070060070067075062060062
42  050055047082050065080065083070078060065070070075085055
43  065055060086070070080070085075078070060065070070057065
44  060065060080060075078074093080080062070055055053057055
45  065052050075065072065056065070057058055055065060060056
46  052050055060060060052061084065060078070078090078065065
47  053052055082058085085072087078075072072075068075068075
48  050049053080080090085093096095095093085083080085075080
49  080070085090085085087085083083080080080080083080080085
50  070065060073070080080073086082085080080076083080080080
51  070070068070068083085083093087086080082085087085087087
52  050063048058057098087088102103087095084080083077090084
53  080055060110100115115108125125123107107104100100097097
54  072064056115090117122112123125113111115106105110120105
55  043037048055042062045055060075055057056055055055045047
56  053055050055058060074065055080063057073055044062065060
57  045047037063052067070055054078048058060060060060057055
58  062060065070065070067069063070060060065065066063068070
59  065065060090070078081075080093080080070070070065065070
60  060062059078078073083080090085085077073078072070067075
```

```
      61      045042044050075080080049085096080065067070062070075075
      62      057047040090080095095090095107090080078075076077072075
      63      053047060090053080105090100093095074083075077073070076
      64      092085077102077105100090105112094100095095095095097095
      65      087090085107104143127113126130117115110107105100110105
      66      080077077103083097115105120127110105102108100108103103
      67      047052050052045060063060065080070073070073065063073057
      68      045045047087060073105085087112090097085065085085085090
      69      050052055090070092105100103123107096093093095095090105
      70       106095115120112125135125136145125118117115110110108107
      71      085070075112087112120110113124107093100090095090100090
      72      076053060120108110125120123140112108107105095100095100
END OF FILE
```

2. Raw data for isokinetic rest-blood pressure
Read 130/088 (systolic/diastolic); 130/086;
130/090; etc.

1	130088130086130090140078132084130088138078134080126086
2	140070142082130086136084128088128086126086130086130086
3	115078112080114080130074130078128070140070124076122076
4	136076130074122076120078122076122076120080120080118080
5	110078112076112078132068118076115076132076128076138076
6	144068136078128074128076124080124076124076120076118070
7	120078118080118080152068140070132074158070140076138078
8	164070142076132076132080132078128078122076118074122070
9	120086120086120086164076150078136080172074150080148078
10	180068168072140080136078130076132076128072120080122080
11	126088126088120088152080142086140080178076164086150088
12	184072156086152088140088130084130080130082128080120080
13	130082128084130080160090140088142088178092158088158088
14	190076160082148084142088142084132082138088130088130088
15	120088118088120090172080160080142082182084166088154088
16	182088160086148088146088138088138090136088134088130090
17	124090126092128090170080156090150090190088170092170090
18	190092170090152090142088142084142088138086132088132082
19	125068124068124068168040146060148068162040158060150060
20	160052148060140060136060136062128062128068128062128066
21	130076132082132080170020170020170025178010178015174015
22	178010166015160030156050152056150056142058140064140066
23	128080130080130078156050144054120066160042158040148042
24	170010152044148050144050138060140066136070132070130072
25	112080116078114076120076120072124080136064120070120070
26	158072130072122076120076120078118078112078114076112078
27	128082126084126084138078140084136086146080138084138080
28	148072150072132082132084134080130082130084130084128082
29	114076116078112078148068128070132078148068140072126084
30	148076140070140070140072138070130070128070120070120072
31	124100126096128100164090158084136084170084150090140092
32	170088150094150094146100138096140100142098142102138100
33	122080124088122080166076150092140080160092150090152090
34	180090160080158084152086150086148084148084138084140088
35	130084130086130086162082160080160080177086170080162084
36	184080170084152088150082150086150080146086144086144084
37	116084112088112084140072138080142080142088132080132084
38	146082142086138090130088132088128090128090124088124088
39	122080122080120080144064140068140080158060148080144080
40	168060140070136070136080136078132080128080126080124080
41	118090120088118090155076136078132082152080132082132088
42	148074138088130076124080122082118084118080116084112086
43	118088118084118078120068116072118072142078126078122080
44	130080136080124082124080124080126080124080122082122084
45	116084118084120088154976150078136080166076150076130080
46	146076130080130086128086124084124080124080124076124084
47	118084118078118082144080138080140082150072132086138080
48	142072128078126080120078120070116078112078112076112072
49	138092132092132094144076140088132088140080120080120088
50	142084132088122084128084124084124084120084118084116088
51	130100130100124092135072120080126080122088128084124080
52	140080136080124084124080120078120082120086120086120088
53	128096124090128096138080132080132082156088136084136088
54	150080130082130080130082128080126084122084120084120086
55	110064112066112064120068116068120070128072122078118080
56	138064126070118072118072116072110070116070120070122074
57	110076110076110076140064128068126072156076140078138078
58	162-72140078136076128074126070118070118070112072112072
59	106074106076104076140070128072128070150068138064130066
60	144070138070130072120072118068110066106070106070106068

61	130084130086132086160074152076156078178078158076154072
62	178076162080144082142080142074140074138068134070134070
63	116074116074118076150062150070138066174060160064154070
64	182070160072150072146070134066132068134074132074130070
65	130084128086128086166072152076150086180052166080156080
66	174072150080146076142076134072130070124070122070124070
67	118082122084120080156080132088130088144080134082134080
68	158084142088140088140088136088132086130086130084126084
69	120088120088122088138084136086132086154084140082140084
70	156088140088140086138082130084130082126084120084124086
71	115086112082114082150070138070130074162078140084138084
72	158086144084138082132088132084132080128080126078122080
73	120084118084118084146070140076138074140064132070120070
74	142064125073122078118076118076124080120080118080118080
75	116074116076116070132040126058126060160040134050130056
76	150048142056136060130060122062120060120070118068110072
77	120084120084120084138062136070130078138046124066124076
78	138050136060136068130070120070120074116078112080110080
79	110078108078104078124080118080114080138078126080120082
80	136070132080132078128078122072122078122080120080116080
81	106074104076106078138060130072126070152068130070134070
82	154060140068130074124074120072118078114076114074114072
83	108080108080110082146070157068126068152076144078140080
84	152068140076132074124076118076112072114070112072112074
85	120070110070110064148058142060130064148060134066134072
86	150052136068130066132066130068128068124070120072120068
87	120076118074112074156040150042148040168040152042148052
88	152056144064140064136066130068120068120068120070122072
89	124072122072122074160040155056154060170048160050150060
90	168048150052158058146060140064140064138064134064128064
91	116078116076116076144074130080130078152072140080136080
92	154068132070132074126070120080120082120084120078120080
93	118078118078114078146070136072134072148068144072138072
94	152060140074138086132080130080124078128078124078122078
95	118084118084116080158064146074140078160078150086150082
96	164068160080148082140084136080130080130072126076124076
97	130084130086130086148070140088136088148074140080140084
98	152068140078132080140080130084130086130084128086126086
99	116090116090116088144070138076138078142070138072130072
100	150072138078132076128076122080120078116078116080116078
101	122088122088124090170068164072155076170078154080148080
102	170068158084138086134080134082130084128084128084126084
103	114080112078112080130066126068128070150060138064126068
104	158060134064132070130072128072124076126078124076120076
105	112080114076112076146068140074128072160068158080140076
106	160064140080138080138078128076122078122076130072126074
107	100078110078110080138064136070130074140050138076140076
108	160058158076154076148076144076140076132078138078138080
109	114084112086112086134080130084124078148076142080136080
110	144076143080132084130082130082124080122080120082118080
111	128088126088124088144076130084132082148072138072138076
112	152068138084128082128084126084124084124084124086124086
113	122090116090118086140068124070122070160062132070134070
114	158056140068136070132074130076128072126080126084124082
115	116070112076110074138058118068110070128058120068112070
116	138060120068112070110068108078108072104074102074102076
117	104070104076102078126064114060112064132060126068120064
118	142068122070122064118068116072110072106072108070106070
119	110076112076110078130060118064118064142060120062108068
120	140064132064118070116070114070114068116070112068110070

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    121      1100841120881140841520581300601220701640401540561400 68
    122      1740421500601320701220681260701220701180701100701160 70
    123      1280801280801300801760561500601420701820301700581540 64
    124      1880301480501440601400641400641320661300701280701260 72
    125      1100801080801120801680661600721440701840681620761580 76
    126      2100401900601580681520681520681400681420701340701320 70
    127      1060721040721040721350781280741240761320701240701220 72
    128      1600721500781280781180741080741060721040781060781060 80
    129      1100681080681080661380561320501300551420601360621300 64
    130      1500601420621380641200661200681200681200701180721160 74
    131      1120861120841120801620521460741280701640561620501400 68
    132      1640601520681440701360701280701240721200721160741140 76
    133      1240781260781200781500601400721340721500701500721420 72
    134      1640721500761480721440781260801240801240801240821220 84
    135      1320901320901340881800721720601640552080251800541600 58
    136      1940201760601590681500661440761500781480781300801380 80
    137      1300841300861300841700581680701640761900351780581700 64
    138      1960451700581700641320681400681400721400801420801420 80
    139      1120841100841120861320701280761260801440681400761300 72
    140      1420521360701340701320701260701200701180701160681100 70
    141      1100761120701140701500561340621300641600301480581320 60
    142      1600401440561160601120641120701120701140701140701120 68
    143      1160741160701180761680201540501380601740601550621550 64
    144      1780401550451400681400681340681220681200661160641160 68
END OF FILE
```

3. Raw data for isokinetic exercise-heart rate
Read 060; 104; 102; 100; 065; etc.

```
 1    060104102100065115112118063112112115
 2    060145155160068153160165061153160169
 3    056132138144053140140150053138147150
 4    055130138128046135150149047120131143
 5    056137145150055140150143054150155162
 6    057110115125064137150148053130139127
 7    083115123137066115118130080135140140
 8    059113115128074150158150060135142150
 9    069135143147073132140148070127140167
10    061118125135060128140145060135145152
11    059120142146052134150153044142153160
12    083135126140070116120125081144148153
13    063090113112080130135142065125133135
14    047108133142049142145157051140150157
15    060136152155061145146148056137143145
16    052140152153053143150152052150160160
17    081135135145064138146159069155160166
18    052162174183070193205207064183190193
19    042125142142053123136138044133143153
20    064100105112064125133138059115132127
21    043143155162049150166172051147163170
22    084165174195085175183187080177187193
23    050130146163049165175175052158175173
24    105163185190077180187193063186190195
END OF FILE
```

4. Raw data for isokinetic exercise-blood pressure
Read 130/88 (systolic/diastolic); 210/66;
200/72; etc.

```
     1      130882106620072189601147918056180501725011177150601506417058
     2      119791645419052180501208618058176581725012588170721906418564
     3      129822106821070210741208918076210682207212791210552206422068
     4      126681981019810190081327919025180101780512880190302051020005
     5      113771604816040190401278518062170562006011379170451704516050
     6      126991706018058180681228419068190481904513085180601754519250
     7      114851906019264189581218017050180402103811990180441824017638
     8      118821606416052148601188417068168701706211882180621685517060
     9      135931506815576160721279717062180721787012796170761848219078
    10      112651985616450166601107615664184561806810675152681706617054
    11      131851885819272194681177418045192281942812986168481883219035
    12      121831905019045190501238816872192721965811484160381794017240
    13      119841685417045168481177215825158101701512087160381682816030
    14      108781647017068168641067615048170521584810981168551606016060
    15      113691922018910202101157419220194101991012374176202051021505
    16      116782057220555210601177817050172641784011783170601804019050
    17      129861885418042196381168919955188301764012388192401964619640
    18      113811605416438158151137715825150201584010778144401483015225
    19      115851484015230158201278914645160301703011788158351602515820
    20      114731405214235150401037414250164481605011176146581585215058
    21      112841701518205190051308318220186101921011081190241981521015
    22      106721624015842158321096814030145301582011384170101781017810
    23      125791625516830166201329019605190101900513184192151971619810
    24      114841402514810152201137315510168051681011674162101701017410
END OF FILE
```

5. Raw data for isometric rest-quadriceps-heart rate
Read 070; 087; 080; 078; 080; etc.

1	070087080078080	61	096060057070074
2	068072075077075	62	077080073072063
3	062063068057075	63	070070056065068
4	058050052052075	64	068053052058072
5	063060067070065	65	066067062065070
6	055055052055060	66	074068080085073
7	080088083065082	67	075060057050056
8	070068070062070	68	060067048060048
9	062063060059080	69	065058053052085
10	060067062062080	70	112092102103098
11	060065063067075	71	067060056057065
12	050050050053070	72	070065070067070
13	060060065080085	73	070080073078084
14	065073073068067	74	090092083087097
15	056063058075085	75	070077052050067
16	058050083054085	76	067062059070055
17	062074057070075	77	080075073074070
18	070055070070064	78	056057059063058
19	065056056062062	79	083095080077090
20	045055045040080	80	080060062065058
21	055062064060050	81	068068065068067
22	087085087087108	82	072082063065067
23	060061072065070	83	064065058063070
24	065058058068074	84	053050045060053
25	080080080075083	85	063063067060065
26	086083086078085	86	082077068073070
27	060065059050070	87	072075072065072
28	065057065060070	88	060050060055070
29	065060078073068	89	074068065068068
30	063060062048061	90	063098087075065
31	084082080073095	91	063055053065063
32	075065068063080	92	070077065055065
33	065067060068065	93	075052067050080
34	070075075065063	94	112110105100103
35	060060070067086	95	070070060060067
36	050053053052055	96	064060053056053
37	063068066066060	97	083082073073072
38	067068072075087	98	090083082085087
39	073074070058088	99	065060055059062
40	070067070058080	100	062053055055052
41	065077066070072	101	077076075074085
42	077060077055078	102	055054057060058
43	043060060055068	103	086079075080078
44	048046055047075	104	072065058075058
45	060050073055067	105	078077065072063
46	106105111100113	106	067061062066060
47	065065060065062	107	085075067070072
48	070062068063073	108	053053043052056
49	087083078074076	109	072072068074062
50	093082090080080	110	075074071073075
51	065062062064072	111	055055058070065
52	075062060050053	112	085055057068050
53	074080083075070	113	077073070068065
54	065055053054057	114	070083060080073
55	085087065090078	115	087083065053055
56	056061071060068	116	062052050057048
57	077065060064070	117	064060050050050
58	070069068058065	118	115120100120100
59	075080070062083	119	065065060072065
60	063055047060047	120	055050055055055

6. Raw data for isometric rest-quadriceps-blood pressure

Read 122/082 (systolic/diastolic); 122/084; 120/084; etc.

1	122082122084120084118090120090
2	120084120082122084122088120090
3	120088122088118088118090120090
4	132090132084128080130096130094
5	130090124090126090126092126100
6	110080110078118076120084118076
7	120084120098118086120078122092
8	140100142100140100142100146100
9	124092122092124090124092124092
10	104078106078108074110076104076
11	128080128084128080128080128086
12	112078110076110076110078112084
13	118084118088120086118086122088
14	112090112090112088112088112088
15	112078114070116076114080116070
16	110080106076110080108080114084
17	120090130094132094134094136098
18	112076110080118080116078116080
19	126092128090128090128090128090
20	110090110088112088112088112088
21	108070106066108068108070110070
22	112080110076108080110078110080
23	106068104068104068104068104070
24	128082126082126082126080126084
25	120084120084124084122086122088
26	130090128088120090122090122088
27	138084136088128088132092132090
28	140088128086138090138088140090
29	120088120090118090122094130100
30	142082134072132070132068132068
31	120084120084120090120090120092
32	155108153100144098142098144098
33	130096128096132090130098130096
34	126072110072110080108078108076
35	138080124086132078132084132086
36	120080112080112080110080110080
37	120084118084116084116086116086
38	120088120086120084120086120086
39	140078136078124074130076124078
40	115088112084112086110084110084
41	144094136098136098140100142100
42	128076118076118076120076116074
43	120088120090118090116090124090
44	128076130078128078128086124080
45	118070116070110070112070110070
46	120080122084108080112086110088
47	106068100070100070100070100068
48	130084130088138086132084132086
	130092128086130084128088126080
	140092130092130112128090130092
	132080132080130070128084118084
	150100160110154094140090140096
3	128096120094124090130088124092
54	140080130064128064124066130068
55	120088130090125084120090122090
56	144096146094146096138098140098
57	146096134090130088132088130088
58	120070118076112076112070110074
59	140084134082128082134082132086
60	122084120080120078120080118076
61	122078112084114078114078112076
62	124080120080122084120086122090
63	140064138070130074130076116072
64	122086114072112080112082114082
65	148090148088132094130088130092
66	130070118072110074114078114078
67	142080130084128088130088128088
68	144070130070126076126078130076
69	120066120064114064110068108064
70	128086118078118078118080120080
71	110060104060100064104070104070
72	136080140086134086138086136086
73	122088122090122088122084122086
74	130096128096110090110092110094
75	132080132080130070128084118084
76	140090138088140088138088142090
77	138090128088128090120084122090
78	150080140084144074130070132068
79	132082122098124092118080120082
80	158108142100144098144100144098
81	140092134092128090128094128088
82	120072112080112072112072114070
83	146080146078144078140080136080
84	120080110076110076108076110076
85	124084122084116084116082114080
86	126090128086119086118086118086
87	136080130076132084134078136076
88	122082112078110080110082110080
89	138090136090126090126092124094
90	128070124072122072118074122076
91	130088128088126090126090124090
92	132076120080134090134090140082
93	122056118060110060110068112070
94	110090118086130088128086126080
95	110070108068108070104068104070
96	138084134080134080136080136080
97	130090124088124088118080120084
98	122090122090124090112090118090
99	132086126080124080120088118090
100	156098148090138088138088138084
101	138098130098130090120090120092
102	130076128074126070127070122072
103	122084120080124082124080122082
104	152110154110144096146096140096
105	132098138100130100130098130094
106	112080110072104072102076102074
107	150080142082140086138086130080
108	124080120082122080120078118084
109	130080128084120080118080118084
110	128088120080120084118084120084
111	130088130080122074120076120076
112	120080120084118084118086118082
113	126098126090130092130090132092
114	130080116074116074116076114070
115	132078130082132080132090130090
116	124084124086122084120086122076
117	120064110064112066110068112070
118	124080128076128074124076128078
119	100068104070100068100068100070
120	138082132084134084134082130082

7. Raw data for isometric rest-hamstrings-heart rate
Read 077; 080; 070; 082; 077; etc.

1	077080070082077
2	085083087078078
3	093058067060064
4	057050057054080
5	067075074080090
6	065052055054080
7	080065080072107
8	057057073057080
9	065067062060065
10	053062058053073
11	052060055050070
12	052051058057065
13	065065063063074
14	067073067065082
15	060060077058078
16	052048050053067
17	062070063070080
18	053060055052087
19	060070055060070
20	045052057047065
21	043050053062045
22	083085097085100
23	070070065065075
24	063055060060065
25	090097078077080
26	086083086078085
27	060065059050070
28	065057065060070
29	065060078073068
30	063060062048061
31	084082080073095
32	075065068063080
33	065067060068065
34	070075075065063
35	060060070067086
36	050053053052055
37	063068066066060
38	067068072075087
39	073074070058088
40	070067070058080
41	065077066070072
42	077060077055078
43	043060060055068
44	048046055047075
45	060050073055067
46	095093083102105
47	066065064065068
48	058065055068070
49	087077072077080
50	093082090080080
51	055065058065072
52	062055062057055
53	080075075090062
54	055053050063065
55	073083078080074
56	061058062055058
57	065073063060073
58	060060055060072
59	055050055055087
60	065068055068068
61	067068068074068
62	074070075078075
63	065057059068078
64	050058051054055
65	070069070067070
66	068073068080064
67	058056053060053
68	065057050058063
69	060065058056048
70	097107080087095
71	065065060068065
72	057050058052075
73	082074080077082
74	083082083092088
75	087052056046085
76	058057060055055
77	078073080075075
78	055053053052059
79	093064078070077
80	067058058058070
81	067066073065065
82	066067057072068
83	053052053054058
84	062062053054057
85	077060065068068
86	067062062067068
87	084052070065080
88	047051052058060
89	070078075077068
90	063053060057060
91	053055055055048
92	083055055056057
93	063048060055070
94	089093090095093
95	065070072063070
96	053067053055053
97	077090077064080
98	080078085075076
99	068064074065064
100	057060057062053
101	082080080075082
102	050057053050050
103	088078078067073
104	065060062063055
105	073065068065063
106	070055060057057
107	066068065065065
108	060055059056065
109	070070070063078
110	072068070069068
111	072060078060080
112	050053052055055
113	065067065072068
114	060070073062065
115	070075075080070
116	053067042066055
117	053050075052055
118	115095103093100
119	067063067065065
120	055065053063055

8. Raw data for isometric rest-hamstrings-blood pressure

Read 120/084 (systolic/diastolic); 116/084; 118/084; etc.

1.	120084116084118084130086124088	61	120078114084114080112080110080
2	110084118090112090116092120096	62	124082122088120084118086122088
3	130090130092128090128090130090	63	140072136072136072124070132070
4	130092128084130090130088130092	64	124086124080120078118080120078
5	130094120096118092120090120096	65	140096132096130100130100132100
6	115068115088118070118070120068	66	140074120076116076118074118080
7	118084120080120084120084128088	67	148090140086136088132088132086
8	122096120096130100130100130104	68	124076122088120084118084118086
9	130096128096128096126094126098	69	120058110066110068110060112066
10	118076116076112076110072110074	70	118074122076118076118070112068
11	136090132090130086130088132090	71	108070104070104068104070104068
12	116078100801100801100801100082	72	140086146082132080134078136082
13	118084118084118082116080114084	73	126108120090120088122096120092
14	122084120086118088120088122088	74	110090110088112092108090112090
15	122076122076124076122080124076	75	130088120090126088120088120090
16	112084112084112084110080112086	76	130094130090128088130088128090
17	122090124092126094124096124096	77	130090120092120090118088122088
18	110076110074108070110070112074	78	128076110078118080120076112084
19	120096118092124096124096126096	79	118088118080118090118086120078
20	118080120084118086118086118086	80	148104138100138098140092140100
21	104068104070104068104066104066	81	132100130096130096128098130098
22	112078112080110078112080114078	82	112084110076112080110080110080
23	106070106068104070104070104070	83	140084140080140078132078134080
24	120080120080120080124084124084	84	118080120082118084118080118084
25	128090130088126088120088118084	85	124086120086118084114084112084
26	115090130090124092120084120096	86	118088118092118090118088118090
27	120090124090120088122090120094	87	136078120078120078126076120072
28	130088120080124088126090124090	88	112076110076112080112080112080
29	124092124088130088122090120090	89	132100124100122100126100130100
30	150090132078140070140070138070	90	118080118080120076114078118078
31	115090118084118084124080120088	91	130090130088130088130090130090
32	142096138096138096138100140096	92	118070118076118078112080112080
33	132098130098130096130098132098	93	122056120070115068115070110068
34	120074112074110074110076110076	94	112076112074110074110076110076
35	140083130080130084128084128084	95	110068112064112068104076108074
36	114080110078108078108078108080	96	140080138080132080136082132086
37	110082110080112080110080108080	97	120094116090120090118088116096
38	112080112080112084110084110084	98	116084112080104088116084112084
39	140070138064136070126078126068	99	130090128088120090120084120088
40	110076112080114084114080110084	100	138090128092126086130090130092
41	134090132092130094132094134096	101	118090110088118082116088110082
42	140082118080118080114080110078	102	118080110076120076116076118080
43	128090126090130090128088130090	103	128080128080128084124080124080
44	142070128076120080120088118080	104	144098140100140098140110140094
45	104066106072106070108066104068	105	128098132096132098130096130098
46	112078108078110080108080110080	106	108084108078108076102070108070
47	104064104064104068106068106068	107	140084142084140082130080130080
48	130080130088130082132088128084	108	112070110078108082108080108080
49	132100126098120084122092120088	109	118086116086116084116082114082
50	118084124090120092112088110096	110	124084120090120090118092118088
51	130090120080138094128090128090	111	124080112080112076116078112076
52	138088140088136090128090132086	112	122080120080120082116080112078
53	132098120094120088118090120090	113	138092138100136098132094132090
54	138088120072124068120070116076	114	114074116074118076114076114076
55	120096120094118086120080122084	115	138080138090130092128092132092
56	140096138090142096138096138092	116	120084116080118082118080114082
57	132098138090134100136094136094	117	122068108072102068104066104068
58	110070110076110080110078110070	118	138074128076120074114072108076
59	138076136084130080132076132076	119	100070104076104072102068104070
60	118078116082112080110080110080	120	134070132088132080130078130082

9. Raw data for isometric exercise-quadriceps-heart rate

Read 110; 087; 078; 090; etc.

```
  1      110087078090
  2      132130110090
  3      080075075066
  4      107120062058
  5      113123095070
  6      140096072060
  7      150133092090
  8      101117080060
  9      112112087072
 10      095093079060
 11      132122085065
 12      108100087058
 13      115122098073
 14      113087072066
 15      133138093074
 16      117118082075
 17      090104076065
 18      160145102085
 19      125105065056
 20      115125080047
 21      133128095052
 22      174181110106
 23      090095085063
 24      140100080060
END OF FILE
```

10. Raw data for isometric exercise-quadriceps-blood pressure

Read 140/110 (systolic/diastolic); 130/100; 120/88; etc.

```
 1     140110130100120088136100
 2     134110140100152110128100
 3     168110150110158124148096
 4     180138190120160110142096
 5     160110160120142110130096
 6     184110182108148088140080
 7     150110155128142100144090
 8     170130170115158120146098
 9     162120150115150100136108
10     150118160106122100116074
11     190130192124160110140084
12     150098148110128088120084
13     150094142100144092128086
14     152104142104136090122090
15     160110166116140096134084
16     160124148114130090120090
17     154120160120140104130096
18     160120160122136104124090
19     172124115108148090130094
20     210140178110140110130084
21     150116150118124090118072
22     152090143092134102130092
23     132100132090120078108076
24     172130164115136090136086
END OF FILE
```

11. Raw data for isometric exercise-hamstrings-heart rate
    Read 100; 096; 085; 085; etc.

```
  1     100096085085
  2     124095085087
  3     082063070073
  4     108105058055
  5     135098080076
  6     135076065062
  7     150147088078
  8     115089070063
  9     105105073065
 10     098087067060
 11     108122078058
 12     124092075072
 13     093093080070
 14     087087077076
 15     150138086081
 16     124125065055
 17     080078066073
 18     130110067060
 19     125085050043
 20     103100063063
 21     117118078055
 22     155145100094
 23     094082066062
 24     116103082063
END OF FILE
```

12. Raw data for isometric exercise-hamstrings-blood pressure

Read (140/110 (systolic/diastolic); 142/110; etc.

```
 1    140110142110138098132096
 2    148120120096128084112088
 3    162112170120140096126090
 4    170138160130144092130090
 5    150120122100128096120090
 6    180110155096140084125080
 7    140115155110144100128092
 8    180118150110150098142096
 9    155112160112136102132096
10    142092140110122084110084
11    168110160118150090136084
12    148114132090126072120078
13    168120128092128084120088
14    148102126106122088118086
15    190138168130138088122082
16    156130150110128090118084
17    160128140100142098136098
18    170092142098124080118072
19    170122142100140088130090
20    152120155130138094118084
21    178110152108130080110068
22    150100136096118080112078
23    142110124084112070108074
24    170130152110150096140088
END OF FILE
```

13. Raw data for isokinetic rest
    (a) mean blood pressure (V28-V36)
    (b) modified tension time index (V37-V45)
    (c) pulse pressure (V46-V54)

1	130. 88.130. 86.130. 90.140. 78.132. 84.130. 88.138. 78.134. 80.126. 86.1 62. 58. 60. 75. 63. 65. 73. 65. 70. 101.90 100.57 103.23 98.57 99.90 101.90 97.90 97.90 99.23 80.60 75.40 78.00 105.00 83.16 84.50 100.74 87.10 88.20 42.00 44.00 40.00 62.00 48.00 42.00 60.00 54.00 40.00
2	140. 70.142. 82.130. 86.136. 84.128. 88.128. 86.126. 86.130. 86.130. 86. 70. 60. 67. 65. 68. 61. 59. 62. 62. 93.24 101.90 100.57 101.23 101.23 99.90 99.23 100.57 100.57 98.00 85.20 87.10 88.40 87.04 78.08 74.34 80.60 80.60 70.00 60.00 44.00 52.00 40.00 42.00 40.00 44.00 44.00
3	115. 78.112. 80.114. 80.130. 74.130. 78.128. 70.140. 70.124. 76.122. 76. 62. 65. 67. 85. 75. 75. 83. 68. 75. 90.24 90.58 91.24 92.57 95.24 89.24 93.24 91.91 91.24 71.30 72.80 76.38 110.50 97.50 96.00 116.20 84.32 91.50 37.00 32.00 34.00 56.00 52.00 58.00 70.00 48.00 46.00
4	136. 76.130. 74.122. 76.120. 78.122. 76.122. 76.120. 80.120. 80.118. 80. 83. 75. 70. 70. 78. 73. 65. 60. 72. 95.90 92.57 91.24 91.91 91.24 91.24 93.24 93.24 92.57 112.88 97.50 85.40 84.00 95.16 89.06 78.00 72.00 84.96 60.00 56.00 46.00 42.00 46.00 46.00 40.00 40.00 38.00
5	110. 78.112. 76.112. 78.132. 68.118. 76.115. 76.132. 76.128. 76.138. 76. 60. 63. 65. 75. 65. 70. 78. 73. 72. 88.58 87.91 89.24 89.24 89.91 88.91 94.57 93.24 96.57 66.00 70.56 72.80 99.00 76.70 80.50 102.96 93.44 99.36 32.00 36.00 34.00 64.00 42.00 39.00 56.00 52.00 62.00
6	144. 68.136. 78.128. 74.128. 76.124. 80.124. 76.124. 76.120. 76.118. 70. 80. 74. 68. 74. 72. 74. 70. 70. 76. 93.24 97.24 91.91 93.24 94.57 91.91 91.91 90.58 85.91 115.20 100.64 87.04 94.72 89.28 91.76 86.80 84.00 89.68 76.00 58.00 54.00 52.00 44.00 48.00 48.00 44.00 48.00
7	120. 78.118. 80.118. 80.152. 68.140. 70.132. 74.158. 70.140. 76.138. 78. 65. 73. 67. 75. 62.110.102. 93.100. 91.91 92.57 82.57 95.90 93.24 93.24 99.23 97.24 97.90 78.00 86.14 79.06 114.00 86.80 145.20 161.16 130.20 138.00 42.00 38.00 38.00 84.00 70.00 58.00 88.00 64.00 60.00
8	164. 70.142. 76.132. 76.132. 80.132. 78.128. 78.122. 76.118. 74.122. 70. 96. 75. 90. 80. 90. 85. 80. 90. 90. 101.23 97.90 94.57 97.24 95.90 94.57 91.24 88.58 87.25 157.44 106.50 118.80 105.60 118.80 108.80 97.60 106.20 109.80 94.00 66.00 56.00 52.00 54.00 50.00 46.00 44.00 52.00
9	120. 86.120. 86.120. 86.164. 76.150. 78.136. 80.172. 74.150. 80.148. 78. 58. 60. 60. 60. 60. 95. 60. 63. 95. 97.24 97.24 97.24 105.23 101.90 98.57 106.56 103.23 101.23 69.60 72.00 72.00 98.40 90.00 129.20 103.20 94.50 140.60 34.00 34.00 34.00 88.00 72.00 56.00 98.00 70.00 70.00
10	180. 68.168. 72.140. 80.136. 78.130. 76.132. 76.128. 72.120. 80.122. 80. 90. 83. 68. 85. 70. 80. 80. 73. 80. 105.23 103.90 99.90 97.24 93.91 94.57 90.58 93.24 93.91 162.00 139.44 95.20 115.60 91.00 105.60 102.40 87.60 97.60 112.00 96.00 60.00 58.00 54.00 56.00 56.00 40.00 42.00
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12	184. 72.156. 86.152. 88.140. 88.130. 84.130. 80.130. 82.128. 80.120. 80. 95. 97. 92. 90. 85. 90. 76. 87. 95. 109.22 109.22 109.22 105.23 99.23 96.57 97.90 95.90 93.24 174.80 151.32 139.84 126.00 110.50 117.00 98.80 111.36 114.00 112.00 70.00 64.00 52.00 46.00 50.00 48.00 48.00 40.00
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14	190. 76.160. 82.148. 84.142. 88.142. 84.132. 82.138. 88.130. 88.130. 88. 70. 60. 65. 57. 62. 61. 70. 58. 60. 113.89 107.89 105.23 105.89 103.23 98.57 104.56 101.90 101.90 133.00 96.00 96.20 80.94 88.04 80.52 96.60 75.40 78.00 114.00 78.00 64.00 54.00 58.00 50.00 50.00 42.00 42.00
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16	182. 88.160. 86.148. 88.146. 88.138. 88.138. 90.136. 88.134. 88.130. 90. 72. 70. 73. 60. 62. 65. 60. 59. 62. 119.21 110.56 107.89 107.23 104.56 105.89 103.90 103.23 103.23 131.04 112.00 108.04 87.60 85.56 89.70 81.60 79.06 80.60 94.00 74.00 60.00 58.00 50.00 48.00 48.00 46.00 40.00
17	124. 90.126. 92.128. 90.170. 80.156. 90.150. 90.190. 88.170. 92.170. 90. 92. 55. 52. 75. 62. 70. 70. 70. 85. 101.23 103.23 102.56 109.89 111.89 109.89 121.88 117.88 116.55 64.48 69.30 66.56 127.50 96.72 105.00 133.00 119.00 144.50 34.00 34.00 38.00 90.00 66.00 60.00 102.00 78.00 80.00
18	190. 92.170. 90.152. 90.142. 88.142. 84.142. 88.138. 86.132. 88.132. 82. 97. 68. 62. 70. 70. 68. 60. 65. 62. 124.54 116.55 110.56 105.89 103.23 105.89 103.23 102.56 98.57 184.30 115.60 94.24 99.40 99.40 96.56 82.80 85.80 81.84 98.00 80.00 62.00 54.00 58.00 54.00 52.00 44.00 50.00
19	125. 68.124. 68.124. 68.168. 40.146. 60.148. 68.162. 40.158. 60.150. 60. 50. 55. 55. 70. 58. 83. 65. 67. 82. 86.91 86.58 86.58 82.58 88.58 94.57 80.59 92.57 89.91 62.50 68.20 68.20 117.60 84.68 122.84 105.30 105.86 123.00 57.00 56.00 56.00 128.00 86.00 80.00 122.00 98.00 90.00
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21 130. 76.132. 82.132. 80.170. 20 170. 20.170. 25.178. 10.178. 15.174. 15. 44. 35. 55. 80 80. 95.105. 90 110. 93.91
98.57 97.24 69.93 69.93 73.26 65.93 69.26 67.93 57.20 46.20 72.60 136.00 136.00 161.50 186.90 160.20 191.
40 54.00 50.00 52.00 150.00 150.00 145.00 168.00 163.00 159.00
22 178. 10.166. 15.160. 30.156 50.152. 56.150. 56.142. 58.140. 64.140. 66.100. 87. 78 76. 75. 75. 74. 76. 73. 65.93
65.27 73.26 85.25 87.91 87.25 85.91 89.24 90.58 178.00 144.42 124.80 118.56 114.00 112.50 105.08 106.40 102.
20 168.00 151.00 130.00 106.00 96.00 94.00 84.00 76.00 74.00
23 128. 80.130. 80.130. 78.156. 50.144. 54.120. 66.160. 42.158 40.148. 42. 57. 43. 44. 62. 61. 54. 73. 68. 78. 95.90
96.57 95.24 85.25 83.92 83.92 81.25 79.25 77.26 72.96 55.90 57.20 96.72 87.84 64.80 116.80 107.44 115.
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26 158. 72.130. 72.122. 76.120. 76.120. 78.118. 78.112. 78.114. 76.112. 78. 76. 72. 73. 63. 68 65. 65. 63. 66. 100.57
91.24 91.24 90.58 91.91 91.24 89.24 88.58 89.24 120.08 93.60 89.06 75.60 81.60 76.70 72.80 71.82 73.
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27 128. 82.126. 84.126. 84.138. 78.140. 84.136. 86.146. 80.138. 84.138. 80. 53. 57. 53. 83. 72. 87. 78. 69. 78. 97.24
97.90 97.90 97.90 102.56 102.56 101.90 101.90 99.23 67.84 71.82 66.78 114.54 100.80 118.32 113.88 95.22 107.
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28 148. 72.150. 72.132. 82.132. 84 134. 80.130. 82.130. 84.130. 84.128. 82. 86. 75. 97. 75. 78. 68. 70. 65. 75. 97.24
97.90 98.57 99.90 97.90 97.90 99.23 99.23 97.24 127.28 112.50 128.04 99.00 104.52 88.40 91.00 84.50 96.
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29 114. 76.116. 78.112. 78.148. 68.128. 70.132. 78.148. 68.140. 72.126. 84. 55. 62. 50. 83. 68. 75. 85. 75. 88. 88.58
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31 124.100.126. 96.128.100.164. 90.158. 84.136. 84.170. 84.150. 90.140. 92. 56. 55. 55. 65. 55. 65. 70. 63. 65. 107.89
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112.55 112.55 115.22 109.89 113.22 112.55 115.22 112.55 122.40 97.50 105.00 102.20 96.60 93.80 102.24 103.66 89.
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33 122. 80.124. 88.122. 80.166 76.150. 92.140. 80.160. 92.150. 90.152. 90. 63. 58. 70. 75. 75. 75. 95. 77. 90. 93.91
99.90 93.91 105.89 111.22 99.90 114.55 109.89 110.56 76.86 71.92 85.40 124.50 112.50 105.00 152.00 115.50 136.
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34 180. 90.160. 80.158. 84.152 86.150. 86.148. 84.148. 84.138. 84.140. 88. 93. 80. 80. 83. 80. 80. 78. 80. 78. 119.88
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08 104.00 86.00 64.00 68.00 64.00 70.00 60.00 58.00 60.00
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95.90 93.24 94.57 99.23 100.57 105.89 97.24 99.90 98.60 100.80 81.76 123.20 96.60 99.40 106.50 99.00 145.
20 32.00 24.00 28.00 68.00 58.00 62.00 54.00 52.00 48.00
38 146. 82.142. 86.138. 90.130. 88.132. 88.128. 90.128. 90.124. 88.124. 88. 77. 90. 80. 77. 75. 78. 80. 73. 74. 103.23
104.56 105.89 101.90 102.56 102.56 102.56 99.90 99.90 112.42 127.80 110.40 100.10 99.00 99.84 102.40 90.52 91.
76 64.00 56.00 48.00 42.00 44.00 38.00 38.00 36.00 36.00
39 122. 80.122. 80.120. 80.144. 64.140. 68.140. 80.158. 60.148. 80.144. 80. 55. 55. 80. 80. 65.107. 70. 87.112. 93.91
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76 28.00 32.00 28.00 79.00 58.00 50.00 72.00 50.00 44.00

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118. 88.118. 84.118. 78.120. 68.116. 72.118. 72.142. 78.126. 78.122. 80. 47. 65. 63. 68. 70. 75. 77. 60. 57. 97.90
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54 30.00 34.00 40.00 52.00 44.00 46.00 64.00 48.00 42.00

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76 50.00 56.00 42.00 44.00 44.00 46.00 44.00 40.00 38.00

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38 74.00 68.00 58.00 48.00 50.00 44.00 36.00 36.00 38.00

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56 102.00 82.00 62.00 62.00 68.00 66.00 70.00 64.00 64.00

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116. 74.116. 74.118. 76.150. 62.150. 70.138. 66.174. 60.160. 64.154. 70. 45. 47. 60. 78. 65. 90. 75. 75. 95. 87.91
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182. 70.160. 72.150. 72.146. 70.134. 66.132. 68.134. 74.132. 74.130. 70. 85. 85. 83. 87. 83. 78. 83. 83. 80. 107.23
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130. 84.128. 86.128. 86.166. 72.152. 76.150. 86.180. 52.166. 80.156. 80. 42. 44. 45. 68. 82. 90. 89. 80. 88. 99.23
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28 46.00 42.00 42.00 94.00 76.00 64.00 128.00 86.00 76.00

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174. 72.150. 80.146. 76.142. 76.134. 72.130. 70.124. 70.122. 70.124. 70.100. 90. 90. 80. 78. 83. 80. 80. 80. 105.89
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96.57 93.24 108.23 102.56 101.90 101.23 99.23 97.90 101.48 100.04 103.20 152.88 129.36 117.00 136.80 120.60 120.
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105.89 105.23 105.23 103.90 101.23 100.57 99.23 97.90 162.74 127.80 133.00 133.00 119.68 132.00 130.00 131.30 107.
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81 106. 74.104. 76.106. 78.138. 60.130. 72.126. 70.152. 68.130. 70.134. 70. 47. 45. 55. 48. 60. 55. 60. 68. 73. 84.58
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82 32.00 28.00 28.00 78.00 58.00 56.00 84.00 60.00 64.00

82 154. 60.140. 68.130. 74.124. 74.120. 72.118. 78.114. 76.114. 74.114. 72. 82. 70. 60. 70. 67. 75. 62. 60. 62. 91.24
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83 108. 80.108. 80.110. 82.146. 70.157. 68.126. 68.152. 76.144. 78.140. 80. 50. 55. 47. 82. 50. 65. 80. 65. 83. 89.24
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84 152. 68.140. 76.132. 74.124. 76.118. 76.112. 72.114. 70.112. 72.112. 74. 70. 78. 60. 65. 70. 70. 75. 85. 55. 95.90
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87 120. 76.118. 74.112. 74.156. 40.150. 42.148. 40.168. 40.152. 42.148. 52. 60. 65. 60. 80. 60. 75. 78. 74. 93. 90.58
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88 152. 56.144. 64.140. 64.136. 66.130. 68.120. 68.120. 68.120. 70.122. 72. 80. 80. 62. 70. 55. 55. 53. 57. 55. 87.91
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89 124. 72.122. 72.122. 74.160. 40.155. 56.154. 60.170. 48.160. 50.150. 60. 65. 52. 50. 75. 65. 72. 65. 56. 65. 89.24
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90 168. 48.150. 52.158. 58.146. 60.140. 64.140. 64.138. 64.134. 64.128. 64. 70. 57. 58. 55. 55. 65. 60. 60. 56. 87.91
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92 154. 68.132. 70.132. 74.126. 70.120. 80.120. 82.120. 84.120. 78.120. 80. 65. 60. 78. 70. 78. 90. 78. 65. 65. 96.57
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50 92.00 66.00 52.00 52.00 50.00 46.00 50.00 46.00 44.00

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00 34.00 34.00 36.00 94.00 72.00 62.00 82.00 64.00 68.00

96 164. 68.160. 80.148. 82.140. 84.136. 80.130. 80.130. 72.126. 76.124. 76. 95. 95. 93. 85. 83. 80. 85. 75. 80. 99.90
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20 34.00 36.00 32.00 70.00 54.00 54.00 82.00 58.00 40.00
120 140. 64.132. 64.118. 70.116. 70 114. 70.114. 68.116. 70.112. 68.110. 70. 85. 85. 77. 73. 78. 72. 70. 67. 75. 89.24
86.58 85.91 85.25 84.58 83.25 85.25 82.58 83.25 119.00 112.20 90.86 84.68 88.92 82.08 81.20 75.04 82.

```
     50  76.00  68.00  48.00  46.00  44.00  46.00  46.00  44.00  40.00
121  110. 84.112. 88.114. 84.152. 58.130. 60.122. 70.164. 40.154. 56 140. 68. 45. 42. 44. 50. 75. 80. 80. 49. 85.  92.57
      95.90  93.91  89.24  83.25  87.25  81.25  88.58  91.91  49.50  47.04  50.16  76.00  97.50  97.60 131.20  75.46 119
     00  26.00  24.00  30.00  94.00  70.00  52.00 124.00  98.00  72.00
122  174. 42.150. 60.132. 70.122. 68 126. 70.122. 70.118. 70.110. 70.116. 70. 96. 80. 65. 67. 70. 62. 70. 75. 75.  85.91
      89.91  90.58  85.91  88.58  87.25  85.91  83.25  85.25 167.04 120.00  85.80  81.74  88.20  75.64  82.60  82.50  87.
     00 132.00  90.00  62.00  54.00  56.00  52.00  48.00  40.00  46.00
123  128. 80.128. 80.130. 80.176. 156 150. 60.142. 70.182. 30.170. 58 154. 64. 57. 47. 40. 90. 80. 85. 95. 90. 95.  95.90
      95.90  96.57  95.90  89.91  93.91  80.59  95.24  93.91  72.96  60.16  52.00 158.40 120.00 134.90 172.90 153.00 166.
     30  48.00  48.00  50.00 120.00  90.00  72.00 152.00 112.00  90.00
124  188. 30.148. 50.144. 60.140. 64 140. 64.132. 66.130. 70 128. 70.126. 72.107. 90. 80. 78. 75. 76. 77. 72. 75.  82.58
      82.58  87.91  89.24  89.24  87.91  89.91  89.24  89.91 201.16 133.20 115.20 109.20 105.00 100.32 100 10  92.16  94.
     50 158.00  98.00  84.00  76.00  76.00  66.00  60.00  58.00  54.00
125  110. 80.108. 80.112. 80.168. 66.160. 72.144. 70.184. 68.162. 76.158. 76. 53. 47. 60. 90. 53. 80.105. 90.100.  89.91
      89.24  90.58  99.90 101.23  94.57 106.56.104.56 103.23  58.30  50.76  67.20 151.20  84.80 115.20 193.20 145.80 158.
     00  30.00  28.00  32.00 102.00  88.00  74.00 116.00  86.00  82.00
126  210. 40.190. 60.158. 68.152. 68.152. 68.140. 68.142. 70.134. 70.132. 70. 93. 95. 74. 83. 75. 77. 73. 70. 76.  96.57
     103.23  97.90  95.90  95.90  91.91  93.91  91.24  90.58 195.30 180.50 116.92 126.16 114.00 107.80 103.66  93.80 100.
     32 170.00 130.00  90.00  84.00  84.00  72.00  72.00  64.00  62.00
127  106. 72.104. 72.104. 72.135. 78.128. 74.124. 76.132. 70.124. 70.122. 72. 92. 85. 77.102. 77.105.100. 90.105.  83.25
      82.58  82.58  86.90  91.91  91.91  90.58  87.91  88.58  97.52  88.40  80.08 137.70  98.56 130.20 132.00 111.60 128.
     10  34.00  32.00  32.00  57.00  54.00  48.00  62.00  54.00  50.00
128  160. 72.150. 78.128. 78.118. 74.108. 74.106. 72.104. 78.106. 78.106. 80.112. 94.100. 95. 95. 95. 95. 97. 95.  101.23
     101.90  94.57  88.58  85.25  83.25  86.58  87.25  88.58 179.20 141.00 128.00 112.10 102.60 100.70  98.80 102.82 100.
     70  88.00  72.00  50.00  44.00  34.00  34.00  26.00  28.00  26.00
129  110. 68.108. 68.108. 66.138. 56.132. 50.130. 55.142. 60.136. 62.130. 64. 87. 90. 85.107.104.143.127.113.126.  81.92
      81.25  79.92  83.25  77.26  79.92  87.25  86.58  85.91  95.70  97.20  91.80 147.66 137.28 185.90 180.34 153.68 163.
     80  42.00  40.00  42.00  82.00  82.00  75.00  82.00  74.00  66.00
130  150. 60.142. 62.138. 64.120. 66.120. 68.120. 68.120. 70.118. 72.116. 74.130.117.115 110.107.105.100.110.105.  89.91
      88.58  88.58  83.92  85.25  85.25  86.58  87.25  87.91 195.00 166.14 158.70 132.00 128.40 126.00 120.00 129.80 121.
     80  90.00  80.00  74.00  54.00  52.00  52.00  60.00  46.00  42.00
131  112. 86.112. 84.112. 80.162. 52.146. 74.128. 70.164. 56.162. 50.140. 68. 80. 77. 77.103  83. 97.115.105.120.  94.57
      93.24  90.58  88.58  97.90  89.24  91.91  87.25  91.91  89.60  86.24  86.24 166.86 121 18 124.16 186.60 170.10 168.
     00  26.00  28.00  32.00 110.00  72.00  58.00 108.00 112.00  72.00
132  164. 60.152. 68.144. 70.136. 70.128. 70.124. 72.120. 72.116. 74.114. 76.127.110.105.102.108.100.108.103.103.  94.57
      95.90  94.57  91.91  89.24  89.24  87.91  87.91  88.58 208.28 167.20 151.20 138.72 138.24 124.00 129.60 119.48 117.
     42 104.00  84.00  74.00  66.00  58.00  52.00  48.00  42.00  38.00
133  124. 78.126. 78.120. 78.150. 60.140. 72.134. 72.150. 70.150. 72.142. 72. 47. 52. 50. 52. 45. 60. 63. 60. 65.  93.24
      93.91  91.91  89.91  94.57  92.57  96.57  97.90  95.24  58.28  65.52  60.00  78.00  63.00  80.40  94.50  90.00  92.
     30  46.00  48.00  42.00  90.00  68.00  62.00  80.00  78.00  70.00
134  164. 72.150. 76.148. 72.144. 78.126. 80.124. 80.124. 80.124. 82.122. 84. 80. 70. 73. 70. 73. 65. 63. 73. 57.  102.56
     100.57  97.24  99.90  95.24  94.57  94.57  95.90  96.57 131.20 105.00 108.04 100.80  91.98  80.60  78.12  90.52  69.
     54  92.00  74.00  76.00  66.00  46.00  44.00  44.00  42.00  38.00
135  132. 90.132. 90.134. 88.180. 72.172. 60.164. 55.208. 25.180. 54 160. 58. 45. 45. 47. 87. 60. 73.105. 85. 87.  103.90
     103.90 103.23 107.89  97.24  91.24  85.91  95.90  91.91  59.40  59.40  62.98 156.60 103.20 119.72 218.40 153.00 139.
     20  42.00  42.00  46.00 108.00 112.00 109.00 183.00 126.00 102.00
136  194. 20.176. 60.159. 68.150. 66.144. 76.150. 78.148. 78.130. 80.138. 80.112. 90. 97. 85. 65. 85. 85. 85. 90.  77.92
      98.57  98.23  93.91  98.57 101.90 101.23  96.57  99.23 217 28 158.40 154.23 127.50  93.60 127.50 125 80 110.50 124.
     20 174.00 116.00  91.00  84.00  68.00  72.00  70.00  50.00  58.00
137  130  84.130. 86.130. 84.170. 58.168. 70.164. 76.190. 35.178. 58.170. 64. 50. 52. 55. 90. 70. 92.105.100.103.  99.23
     100.57  99.23  95.24 102.56 105.23  86.58  97.90  99.23  65.00  67.60  71.50 153.00 117.60 150.88 189.50 178.00 175.
     10  46.00  44.00  46.00 112.00  98.00  88.00 155.00 120.00 106.00
138  196  45.170. 58.170. 64.132. 68.140. 68.140. 72.140. 80.142. 80.142. 80.123.107. 96  93. 93. 95. 95. 90.105.  95.24
      95.24  99.23  89.24  91.91  94.57  99.90 100.57 100.57 241 08 181 90 163 20 122.76 130.20 133.00 133.00 127.80 149.
     10 151.00 112.00 106.00  64.00  72.00  68.00  60.00  62.00  62.00
139  112. 84.110. 84.112. 86.132. 70.128. 76.126. 80.144. 68 140  76.130. 72.106. 95.115.120.112.125.135.125.136.  93.24
      92.57  94.57  90.58  93.24  95.24  93.24  97.24  91.24 118.72 104.50 128.80 158.40 143.36 157.50 194.40 175.00 176.
     80  28.00  26.00  26.00  62.00  52.00  46.00  76.00  64.00  58.00
140  142. 52.136. 70.134. 70.132. 70.126. 70.120. 70.118. 70.116. 68.110. 70.145.125.118.117.115.110.110.108.107.  81.92
      91.91  91.24  90.58  88.58  86.58  85.91  83.92  83.25 205.90 170.00 158.12 154.44 144.80 132.00 129.80 125.28 117
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70 90.00 66.00 64.00 62.00 56.00 50.00 48.00 48.00 40.00
141 110. 76.112. 70.114. 70.150. 56.134. 62.130. 64.160. 30.148. 58.132. 60. 85. 70. 75.112. 87 112.120.110.113. 87.25
83.92 84.58 87.25 85.91 85.91 73.26 87.91 83.92 93.50 78.40 85.50 168.00 146.58 145.60 192.00 162.80 149.
16 34.00 42.00 44.00 94.00 72.00 66.00 130.00 90.00 72.00
142 160. 40.144. 56.116. 60.112. 64.112. 70.112. 70.114. 70.114. 70.112. 68.124.107. 93.100. 90. 95. 90.100. 90. 79.92
85.25 78.59 79.92 83.92 83.92 84.58 84.58 82.58 198.40 154.08 107.88 112.00 100.80 106.40 102.60 114.00 100.
80 120.00 88.00 56.00 48.00 42.00 42.00 44.00 44.00 44.00
143 116. 74.116. 70.118. 76.168. 20.154. 50.138. 60.174. 60.155. 62.155. 64. 76. 53. 60.120.108.110.125.120.123. 87.91
85.25 89.91 69.26 84.58 85.91 87.90 92.91 94.24 88.16 61.48 70.80 201.60 166.32 151.80 217.80 186.00 190.
65 42.00 46.00 42.00 148.00 104.00 78.00 114.00 93.00 91.00
144 178. 40.155. 45.140. 68.140. 68.134. 68.122. 68.120. 66.116. 64.116. 68.140.112.108.107.105. 95.100. 95.100. 85.91
81.58 91.91 91.91 89.91 85.91 83.92 81.25 83.92 249.20 173.60 151.20 149.80 140.70 115.90 120.00 110.20 116.
00 138.00 110.00 72.00 72.00 66.00 54.00 54.00 52.00 48.00

14. Raw data for isokinetic exercise
    (a) mean blood pressure (V37-V48)
    (b) modified tension time index (V49-V60)
    (c) pulse pressure (V61-V72)

1	130. 88.210. 66 200. 72.189 60 114. 78 180. 56.180. 50.172. 50 111. 77.150. 60.150. 64.170 58 60.104.102.100. 65. 115.112.118 63.112.112.115 10..90 113.89 114.55 102.80 90.58 97.24 93.24 90.58 88.24 89.91 92.57 95.24 78 .00 218.40 204.00 189.00 74.10 207.00 201.60 202.96 69.93 168.00 168.00 195.50 42 00 144.00 128.00 129.00 35.00 124.00 130.00 122.00 34.00 90.00 86.00 112.00
2	119. 79.164. 54.190. 52.180. 50.120. 86.180. 58.176. 58.172. 50.125. 88.170. 72.190. 64.185. 64 60.145.155.160. 68. 153.160.165. 61.153.160.169. 92.24 90.58 97.90 93.24 97.24 98.57 97.24 90.58 100.23 104.56 105.89 104 23 71 .40 237.80 294.50 288.00 81.60 275.40 281.60 283.80 76.25 260 10 304.00 312.65 40.00 110.00 138.00 130.00 34.00 122.00 118.00 122.00 37.00 98.00 126.00 121.00
3	129. 82.210. 68.210. 70.210. 74.120. 89.180. 76.210. 68.220. 72.127. 91.210. 55.220. 64.220. 68. 56.132.138.144. 53. 140.140.150. 53.138.147.150. 97.57 115.22 116.55 119.21 99.23 110.56 115.22 121.21 102.90 106.56 115.88 118.55 72 .24 277.20 289.80 302.40 63.60 252.00 294.00 330.00 67.31 289.80 323.40 330.00 47.00 142.00 140.00 136.00 31.00 104.00 142.00 148.00 36.00 155.00 156.00 152.00
4	126. 68.198. 10 198. 10.190. 8.132. 78.180. 25.180. 10.178. 5.128. 80.190. 30.205. 10.200. 5. 55.130.138.128. 46. 135.150.149. 47.120.131.143. 87.25 72.59 72.59 68.60 96.57 79.92 66.60 62.60 95.90 83 25 74.92 69.93 69 .30 257.40 273.24 243.20 60.72 256.50 270.00 265.22 60.16 228.00 268.55 286.00 58.00 188.00 188.00 182.00 53.00 165.00 170.00 173.00 48.00 160.00 195.00 195.00
5	113. 77.160. 48.160. 40.190. 40.127. 85.180. 62.170. 56.200. 60.113. 79.170. 45.170. 45.160. 50. 56.137.145.150. 55. 140.150.143. 54.150.155.162. 88.91 85.25 79.92 89.91 98.90 101.23 93.91 106.56 90.24 86.58 86.58 86.58 63 .28 219.20 232.00 285.00 69.85 252.00 255.00 286.00 61.02 255.00 263.50 259.20 36.00 112.00 120.00 150.00 42.00 118.00 114.00 140.00 34.00 125.00 125.00 110.00
6	126. 99.170. 60 180. 58.180. 68.122. 84.180. 68.190. 48.190. 45 130. 85.180. 60.175. 45.192. 50. 57.110.115.125. 64. 137.150.148. 53.130.139.127. 107.89 96.57 98.57 105.23 96.57 108.56 95.24 93.24 99.90 99.90 88.24 97 24 71 .82 187.00 207.00 225.00 78.08 260.30 285.00 281.20 68.90 234.00 243.25 243.84 27.00 110.00 122.00 112.00 38.00 122.00 142.00 145.00 45.00 120.00 130.00 142.00
7	114. 85.190. 60.192. 64.189. 58.121. 80.170. 50.180. 40.210. 38.119. 90.180. 44.182. 40.176. 38. 83.115.123.137. 66. 115.118.130. 80.135.140.140. 94.57 103.23 106.56 101.56 93.57 89.91 86.58 95.24 99.57 89.24 87.25 83.92 94 .62 218.50 236.16 258.93 79.86 195.50 212.40 273.00 95.20 243.00 254.80 246.40 29.00 130.00 128.00 131.00 41.00 120.00 140.00 172.00 29.00 136.00 142.00 138.00
8	118. 82.160. 64.160. 52.148. 60.118. 84.170. 68.168. 70.170. 62.118. 82.180. 62.168. 55.170. 60. 59.113.115.128. 74. 150.158.150. 60.135.142.150. 93.91 95.90 87.91 89.24 95.24 101.90 102.56 97.90 93.91 101.23 92.57 96.57 69 .62 180.80 184.00 189.44 87.32 255.00 265.44 255.00 70.80 243.00 238.56 255.00 36.00 96.00 108.00 88.00 34.00 102.00 98.00 108.00 36.00 118.00 113.00 110.00
9	135. 93.150. 68.155. 76.160. 72.127. 97.170. 62.180. 72.178. 70.127. 96.170. 76.184. 82.190. 78. 69.135.143.147. 73. 132.140.148. 70.127.140.167. 106.89 95.24 102.23 101.23 106.89 97.90 107.89 105.89 106.23 107.23 115.88 115.22 93 .15 202.50 221.65 235.20 92.71 224.40 252.00 263.44 88.90 215.90 257.60 317.30 42.00 82.00 79.00 88.00 30.00 108.00 108.00 108.00 31.00 94.00 102.00 112.00
10	112. 65.198. 56.164. 50.166. 60.110. 76.156. 64.184. 56.180. 68.106. 75.152. 68.170. 66.170. 54. 61.118.125.135. 60. 128.140.145. 60.135.145.152. 80.59 103.23 87.91 95.24 87.25 94.57 98.57 105.23 85.25 95.90 100.57 92.57 68 .32 233.64 205.00 224.10 66.00 199.68 257.60 261.00 63.60 205.20 246.50 258.40 47.00 142.00 114.00 106.00 34.00 92.00 128.00 112.00 31.00 84.00 104.00 116.00
11	131. 85.188. 58.192. 72.194. 68.117. 74.180. 45.192. 28.194. 28.129. 86.168. 48.188. 32.190. 35. 59.120.142.146. 52. 134.150.153. 44.142.153.160. 100.23 101.23 111.89 109.89 88.24 89.91 82.58 83.25 100.23 87.91 83.92 86.58 77 .29 225.60 272.64 283.24 60.84 241.20 288.00 286.82 56.76 238.56 287.64 304.00 46.00 130.00 120.00 126.00 43.00 135.00 164.00 166.00 43.00 120.00 156.00 155.00
12	121. 83.190. 50.190. 45.190. 50.123. 88.168. 72.192. 72.196. 58.114 84.160. 38.179. 40.172. 40. 83.135.126.140. 70. 116.120.125. 81.144.148.153. 95.57 96.57 93.24 96.57 99.57 103.90 111.89 103.90 93.91 78.59 86.25 83.92 100 .43 256.50 239.40 266.00 86.10 194.88 230.40 245.00 92.34 230.40 264.92 263.16 38.00 140.00 145.00 140.00 35.00 96.00 120.00 138.00 30.00 122.00 139.00 132.00
13	119. 84.168. 54.170. 45.168. 48.117. 72.158. 25.158. 10.170. 15.120. 87.160. 38.168. 28.160. 30. 63. 90.113.112. 80. 130.135.142. 65.125.133.135. 95.57 91.91 86.58 87.91 86.91 69.26 59.27 66.60 97.90 78.59 74.59 73.26 74 .97 151.20 192.10 188.16 93.60 205.40 213.30 241.40 78.00 200.00 223.44 216.00 35.00 114.00 125.00 120.00 45.00 133.00 148.00 155.00 33.00 122.00 140.00 130.00
14	108. 78.164. 70.170. 68.168. 64.106. 76.150. 48.170. 52.158. 48.109. 81.168. 55.160. 60.160. 60. 47.108.133.142. 49. 142.145.157. 51.140.150.157. 87.91 101.23 101.90 98.57 85.91 81.92 91.24 84.58 90.24 92.57 93.24 93.24 50 .76 177.12 226.10 238.56 51.94 213.00 246.50 248.06 55.59 235.20 240.00 251.20 30.00 94.00 102.00 104.00 30.00 102.00 118.00 110.00 28.00 113.00 100.00 100.00
15	113. 69.192. 20.189. 10.202. 10.115. 74.192. 20.194. 10.199. 10.123. 74.176. 20.205. 10.215. 5. 60.136.152.155. 61. 145.146.148. 56.137.143.145. 83.58 77.26 69.60 73.93 87.58 77.26 71.26 72.93 90.24 71.93 74.92 74 92 67 .80 261.12 287.28 313.10 70.15 278.40 283.24 294.52 68.88 241.12 293.15 311.75 44.00 172.00 179.00 192.00 41.00

172.00 184.00 189.00 49.00 156.00 195.00 210.00

16 116. 78.205. 72 205 55.210. 60.117. 78.170. 50.172. 64.178. 40.117. 83.170. 60.180. 40.190. 50. 52.140.152.153. 53.
143.150.152. 52.150.160.160. 90.58 116.22 104.89 109.89 90.91 89.91 99.90 85.91 94.24 96.57 86.58 96.57 60
.32 287.00 311.60 321.30 62.01 243.10 258.00 270.56 60.84 255.00 288.00 304.00 38.00 133.00 150.00 150.00 39.00
120.00 108.00 138.00 34.00 110.00 140.00 140.00

17 129. 86.188. 54.180. 42 196 38.116. 89.199. 55.188. 30.176. 40.123. 88.192. 40.196. 46.196. 40. 81.135.135.145. 64.
138.146.159. 69.155.160.166. 100.23 98.57 87.91 90.58 97.90 102.90 82.58 85.25 99.57 90.58 95.90 91.91 104
.49 253.80 243.00 284.20 74.24 274.62 274.48 279.84 84.87 297.60 313.60 325.36 43.00 134.00 138.00 158.00 27.00
144.00 158.00 136.00 35.00 152.00 150.00 156.00

18 113. 81.160. 54.164. 38.158. 15.113. 77.158. 25.150. 20.158. 40.107. 78.144. 40.148. 30.152. 25. 52.162.174.183. 70.
193.205.207. 64.183.190.193. 91.57 89.24 79.92 62.60 88.91 69.26 63.27 79.25 87.58 74.59 69.26 67.27 58
.76 259.20 285.36 289.14 79.10 304.94 307.50 327.06 68.48 263.52 281.20 293.36 32.00 106.00 126.00 143.00 36.00
133.00 130.00 118.00 29.00 104.00 118.00 127.00

19 115. 85.148. 40 152. 30.158. 20.127. 89.146. 45.160. 30.170. 30.117. 88.158. 35.160. 25.158. 20. 42.125.142.142. 53.
123.136.138. 44.133.143.153. 94.90 75.92 70.60 65.93 101.56 78.59 73.26 76.59 97.57 75.92 69.93 65.93 48
.30 185.00 215.84 224.36 67.31 179.58 217.60 234.60 51.48 210.14 228.80 241.74 30.00 108.00 122.00 138.00 38.00
101.00 130.00 140.00 29.00 123.00 135.00 138.00

20 114. 73.140. 52.142. 38.150. 40.103. 74.142. 50.164. 48.160. 50.111. 76.146. 58.158. 52.150. 58. 64.100.105.112. 64.
125.133.138. 59.115.132.127. 86.58 81.25 70.60 76.59 83.58 80.59 86.58 86.58 87.58 87.25 87.25 88.58 72
.96 140.00 149.10 168.00 65.92 177.50 218.12 220.80 65.49 167.90 208.56 190.50 41.00 88.00 107.00 110.00 29.00
92.00 116.00 110.00 35.00 88.00 106.00 92.00

21 112. 84.170. 15.182. 5.190. 5.130. 83.182. 20.186. 10.192. 10.110. 81.190. 24.198. 15.210. 15. 43.143.155.162. 49.
150.166.172. 51.147.163.170. 93.24 66.60 63.94 66.60 98.57 73.93 68.60 70.60 90.58 79.25 75.92 79.92 48
.16 243.10 282.10 307.80 63.70 273.00 308.76 330.24 56.10 279.30 322.74 357.00 28.00 155.00 177.00 185.00 47.00
162.00 176.00 182.00 29.00 166.00 183.00 195.00

22 106. 72.162. 40 158. 42.158. 32.109. 68.140. 30.145. 30.158. 20.113. 84.170. 10.178. 10.178. 10. 84.165.174.195. 85.
175.183.187. 80.177.187.193. 83.25 80.59 80.59 73.93 81.58 66.60 68.26 65.93 93.57 63.27 65.93 65.93 89
.04 267.30 274.92 308.10 92.65 245.00 265.35 295.46 90.40 300.90 332.86 343.54 34.00 122.00 116.00 126.00 41.00
110.00 115.00 138.00 29.00 160.00 168.00 168.00

23 125. 78.162. 55.168. 30.166. 20.132. 90.196. 5.190. 10.190. 5.131. 84.192. 15.197. 16.198. 10. 50.130.146.163. 49.
165.175.175. 52.158.175.173. 94.24 90.58 75.92 68.60 103.90 68.60 69.93 66.60 99.57 73.93 76.26 72.59 62
.50 210.60 245.28 270 58 64.68 323.40 332.50 332.50 68.12 303.36 344.75 342.54 46.00 107.00 138.00 146.00 42.00
191.00 180.00 185.00 47.00 177.00 181.00 188.00

24 114. 84 140. 25.148. 10.152. 20.113. 73.155. 10.168. 5.168. 10.116. 74.162. 10.170. 10.174. 10.105.163.185.190. 77.
180.187.193. 63.186.190.195. 93.91 63.27 55.94 63.94 86.25 58.27 59.27 62.60 87.91 60.61 63.27 64.60 119
.70 228.20 273.80 288.80 87.01 279.00 314.16 324.24 73.08 301.32 323.00 339.30 30.00 115.00 138.00 132.00 40.00
145.00 163.00 158.00 42.00 152.00 160.00 164.00

15. Raw data for isometric rest-quadriceps
    (a) mean blood pressure (V16-V20)
    (b) modified tension time index (V21-V25)
    (c) pulse pressure (V26-V30)

1	122.	82.	122.	84.	120.	84.	118.	90.	120.	90.	70.	87.	80.	78.	80.	95.24	96.57	95.90	99.23	99.90	85.40	106.14	96.00
	92.04	96.00	40.00	38.00	36.00	28.00	30.00																
2	120.	84.	120.	82.	122.	84.	122.	88.	120.	90.	68.	72.	75.	77.	75.	95.90	94.57	96.57	99.23	99.90	81.60	86.40	91.50
	93.94	90.00	36.00	38.00	38.00	34.00	30.00																
3	120.	88.	122.	88.	118.	88.	118.	90.	120.	90.	62.	63.	68.	57.	75.	98.57	99.23	97.90	99.23	99.90	74.40	76.86	80.24
	67.26	90.00	32.00	34.00	30.00	28.00	30.00																
4	132.	90.	132.	84.	128.	80.	130.	96.	130.	94.	58.	50.	52.	52.	75.	103.90	99.90	95.90	107.23	105.89	76.56	66.00	66.56
	67.60	97.50	42.00	48.00	48.00	34.00	36.00																
5	130.	90.	124.	90.	126.	90.	126.	92.	126.	100.	63.	60.	67.	70.	65.	103.23	101.23	101.90	103.23	108.56	81.90	74.40	84.42
	88.20	81.90	40.00	34.00	36.00	34.00	26.00																
6	110.	80.	110.	78.	118.	76.	120.	84.	118.	76.	55.	55.	52.	55.	60.	89.91	88.58	89.91	95.90	89.91	60.50	60.50	61.36
	66.00	70.80	30.00	32.00	42.00	36.00	42.00																
7	120.	84.	120.	98.	118.	86.	120.	78.	122.	92.	80.	88.	83.	65.	82.	95.90	105.23	96.57	91.91	101.90	96.00	105.60	97.94
	78.00	100.04	36.00	22.00	32.00	42.00	30.00																
8	140.	100.	142.	100.	140.	100.	142.	100.	146.	100.	70.	68.	70.	62.	70.	113.22	113.89	113.22	113.89	115.22	98.00	96.56	98.00
	88.04	102.20	40.00	42.00	40.00	42.00	46.00																
9	124.	92.	122.	92.	124.	90.	124.	92.	124.	92.	62.	63.	60.	59.	80.	102.56	101.90	101.23	102.56	102.56	76.88	76.86	74.40
	73.16	99.20	32.00	30.00	34.00	32.00	32.00																
10	104.	78.	106.	78.	108.	74.	110.	76.	104.	76.	60.	67.	62.	62.	80.	86.58	87.25	85.25	87.25	85.25	62.40	71.02	66.96
	68.20	83.20	26.00	28.00	34.00	34.00	28.00																
11	128.	80.	128.	84.	128.	80.	128.	80.	128.	86.	60.	65.	63.	67.	75.	95.90	98.57	95.90	95.90	99.90	76.80	83.20	80.64
	85.76	96.00	48.00	44.00	48.00	48.00	42.00																
12	112.	78.	110.	76.	110.	76.	110.	78.	112.	84.	50.	50.	50.	53.	70.	89.24	87.25	87.25	88.58	93.24	56.00	55.00	55.00
	58.30	78.40	34.00	34.00	34.00	32.00	28.00																
13	118.	84.	118.	88.	120.	86.	118.	86.	122.	88.	60.	60.	65.	80.	85.	95.24	97.90	97.24	96.57	99.23	70.80	70.80	78.00
	94.40	103.70	34.00	30.00	34.00	32.00	34.00																
14	112.	90.	112.	90.	112.	88.	112.	88.	112.	68.	65.	73.	73.	68.	67.	97.24	97.24	95.90	95.90	95.90	72.80	81.76	81.76
	76.16	75.04	22.00	22.00	24.00	24.00	24.00																
15	112.	72.	114.	70.	116.	76.	114.	80.	116.	70.	56.	63.	58.	75.	85.	85.25	84.58	89.24	91.24	85.25	62.72	71.82	67.28
	85.50	98.60	40.00	44.00	40.00	34.00	46.00																
16	110.	80.	106.	76.	110.	80.	108.	80.	114.	84.	58.	50.	83.	54.	85.	89.91	85.91	89.91	89.24	93.91	63.80	53.00	91.30
	58.32	96.90	30.00	30.00	30.00	28.00	30.00																
17	120.	90.	130.	94.	132.	94.	134.	94.	136.	98.	62.	74.	57.	70.	75.	99.90	105.89	106.56	107.23	110.56	74.40	96.20	75.24
	93.80	102.00	30.00	36.00	38.00	40.00	38.00																
18	112.	76.	110.	80.	118.	80.	116.	78.	116.	80.	70.	55.	70.	70.	64.	87.91	89.91	92.57	90.58	91.91	78.40	60.50	82.60
	81.20	74.24	36.00	30.00	38.00	38.00	36.00																
19	126.	92.	128.	90.	128.	90.	128.	90.	128.	90.	65.	56.	56.	62.	62.	103.23	102.56	102.56	102.56	102.56	81.90	71.68	71.68
	79.36	79.36	34.00	38.00	38.00	38.00	38.00																
20	110.	90.	110.	88.	112.	88.	112.	88.	112.	88.	45.	55.	45.	40.	80.	96.57	95.24	95.90	95.90	95.90	49.50	60.50	50.40
	44.80	89.60	20.00	22.00	24.00	24.00	24.00																
21	108.	70.	106.	66.	108.	68.	108.	70.	110.	70.	55.	62.	64.	60.	50.	82.58	79.25	81.25	82.58	83.25	59.40	65.72	69.12
	64.80	55.00	38.00	40.00	40.00	38.00	40.00																
22	112.	80.	110.	76.	108.	80.	110.	78.	110.	80.	87.	85.	87.	87.	108.	90.58	87.25	89.24	88.58	89.91	97.44	93.50	93.96
	95.70	118.80	32.00	34.00	28.00	32.00	30.00																
23	106.	68.	104.	68.	104.	68.	104.	68.	104.	70.	60.	61.	72.	65.	70.	80.59	79.92	79.92	79.92	81.25	63.60	63.44	74.88
	67.60	72.80	38.00	36.00	36.00	36.00	34.00																
24	128.	82.	126.	82.	126.	82.	126.	80.	126.	84.	65.	58.	58.	68.	74.	97.24	96.57	96.57	95.24	97.90	83.20	73.08	73.08
	85.68	93.24	46.00	44.00	44.00	46.00	42.00																
25	120.	84.	120.	84.	124.	84.	122.	86.	122.	88.	80.	80.	80.	75.	83.	95.90	95.90	97.24	97.90	99.23	96.00	96.00	99.20
	91.50	101.26	36.00	36.00	40.00	36.00	34.00																
26	130.	90.	128.	88.	120.	90.	122.	90.	122.	88.	86.	83.	86.	78.	85.	103.23	101.23	99.90	100.57	99.23	111.80	106.24	103.20
	95.16	103.70	40.00	40.00	30.00	32.00	34.00																
27	138.	84.	136.	88.	128.	88.	132.	92.	132.	90.	60.	65.	59.	50.	70.	101.90	103.90	101.23	105.23	103.90	82.80	88.40	75.52
	66.00	92.40	54.00	48.00	40.00	40.00	42.00																
28	140.	88.	128.	86.	138.	90.	138.	88.	140.	90.	65.	57.	65.	60.	70.	105.23	99.90	105.89	104.56	106.56	91.00	72.96	89.70
	82.80	98.00	52.00	42.00	48.00	50.00	50.00																
29	120.	88.	120.	90.	118.	80.	122.	94.	130.	100.	65.	60.	78.	73.	68.	98.57	99.90	99.23	103.23	109.89	78.00	72.00	92.04
	89.06	88.40	32.00	30.00	28.00	28.00	30.00																
30	142.	82.	134.	72.	132.	70.	132.	68.	132.	68.	63.	60.	62.	48.	61.	101.90	92.57	90.58	89.24	89.24	89.46	80.40	81.84

| | | |

72.00 55.46 38.00 40.00 42.00 40.00 42.00
61 122. 78.112. 84.114. 78.114. 78.112. 76. 96 60. 57. 70. 74 92.57 93.24 89.91 89.91 87.91 117.12 67.20 64.98
79.80 82.88 44.00 28.00 36.00 36.00 36.00
62 124. 80.120. 80.122. 84.120. 86.122. 90. 77. 80. 73. 72. 63. 94.57 93.24 96.57 97.24 100.57 95.48 96.00 89.06
86.40 76.86 44.00 40.00 38.00 34.00 32.00
63 140. 64.138. 70.138. 74.130. 76 116. 72. 70. 70. 56. 65. 68. 89.24 92.57 95.24 93.91 86.58 98.00 96.60 77.28
84.50 78.88 76.00 68.00 64.00 54.00 44.00
64 122. 86.114. 72.112. 80.112. 82.114. 82. 68. 53. 52. 58. 72. 97.90 85.91 90.58 91.91 92.57 82.96 60.42 58.24
64.96 82.08 36.00 42.00 32.00 30.00 32.00
65 148. 90.148. 88.132. 94.130. 88.130 92. 66. 67. 62. 65. 70. 109.22 107.89 106.56 101.90 104.56 97.68 99.16 81.84
84.50 91.00 58.00 60.00 38.00 42.00 38.00
66 130. 70.118. 72.110. 74.114. 78.114. 78. 74. 68. 80. 85. 73. 89.91 87.25 85.91 89.91 89.91 96.20 80.24 88.00
96.90 83.22 60.00 46.00 36.00 36.00 36.00
67 142. 80.130. 84.128. 88.130. 88.128. 88. 75. 60. 57. 50. 56. 100.57 99.23 101.23 101.90 101.23 106.50 78.00 72.96
65.00 71.68 62.00 46.00 40.00 42.00 40.00
68 144. 70.130. 70.126. 76.126. 78.130. 76. 60. 67. 48. 60. 48. 94.57 89.91 92.57 93.91 93.91 86.40 87.10 60.48
75.60 62.40 74.00 60.00 50.00 48.00 54.00
69 120. 66.120. 64.114. 64.110. 68.108. 64. 65. 58. 53. 52. 85. 83.92 82.58 80.59 81.92 78.59 78.00 69.60 60.42
57.20 91.80 54.00 56.00 50.00 42.00 44.00
70 128. 86.118. 78.118. 78.118. 80.120. 80.112. 92.102.103. 98. 99.90 91.24 91.24 92.57 93.24 143.36 108.56 120.36
121.54 117.60 42.00 40.00 40.00 38.00 40.00
71 110. 60.104. 60.100. 64.104. 70.104. 70. 67. 60. 56. 57. 65. 76.59 74.59 75.92 81.25 81.25 73.70 62.40 56.00
59.28 67.60 50.00 44.00 36.00 34.00 34.00
72 136. 80.140. 86.134. 86.138. 86.136. 86. 70. 65. 70. 67. 70. 98.57 103.90 101.90 103.23 102.56 95.20 91.00 93.80
92.46 95.20 56.00 54.00 48.00 52.00 50.00
73 122. 88.122. 90.122. 88.122. 84.122. 86. 70. 80. 73. 78. 84. 99.23 100.57 99.23 96.57 97.90 85.40 97.60 89.06
95.16 102.48 34.00 32.00 34.00 38.00 36.00
74 130. 96.128. 96.110. 90.110. 92.110. 94. 90. 92. 83. 87. 97. 107.23 106.56 96.57 97.90 99.23 117.00 117.76 91.30
95.70 106.70 34.00 32.00 20.00 18.00 16.00
75 130. 90.128. 88.128. 80.128. 80.126. 86. 70. 77. 52. 50. 67. 103.23 101.23 95.90 95.90 99.23 91.00 98.56 66.56
64.00 84.42 40.00 40.00 48.00 48.00 40.00
76 140. 90.138. 88.140. 88.138. 88.142. 90. 67. 62. 59. 70. 55. 106.56 104.56 105.23 104.56 107.23 93.80 85.56 82.60
96.60 78.10 50.00 50.00 52.00 50.00 52.00
77 138. 90.128. 88.128. 80.120. 84.122. 90. 80. 75. 73. 74. 70. 105.89 101.23 102.56 95.90 100.57 110.40 96.00 93.44
88.80 85.40 48.00 40.00 38.00 36.00 32.00
78 150. 80.140. 84.144. 74.130. 70.132. 68. 56. 57. 59. 63. 58. 103.23 102.56 97.24 89.91 89.24 84.00 79.80 84.96
81.90 76.56 70.00 56.00 70.00 60.00 64.00
79 132. 82.122. 98.124. 92.118. 80.120. 82. 83. 95. 80. 77. 80. 98.57 105.89 102.56 92.57 94.57 109.56 115.80 99.20
90.86 108.00 50.00 24.00 32.00 38.00 38.00
80 158.108.142.100.144. 98.144.100.144. 98. 80. 60. 62. 65. 58. 124.54 113.89 113.22 114.55 113.22 126.40 85.20 89.28
93.60 83.52 50.00 42.00 46.00 44.00 46.00
81 140. 92.134. 92.128. 90.128. 94.128. 88. 68. 68. 65. 68. 67. 107.89 105.89 102.56 105.23 101.23 95.20 91.12 83.20
87.04 85.76 48.00 42.00 38.00 34.00 40.00
82 120. 72.112. 80.112. 72.112. 72.114. 70. 72. 82. 63. 65. 67. 87.91 90.58 85.25 85.25 84.58 86.40 91.84 70.56
72.80 76.38 48.00 32.00 40.00 40.00 44.00
83 146. 80.146. 78.144. 78.140. 80.136. 80. 64. 65. 58. 63. 70. 101.90 100.57 99.90 99.90 98.57 93.44 94.90 83.52
88.20 95.20 66.00 68.00 66.00 60.00 56.00
84 120. 80.110. 76.110. 76.108. 76.110. 76. 53. 50. 45. 60. 53. 93.24 87.25 87.25 86.58 87.25 63.60 55.00 49.50
64.80 58.30 40.00 34.00 34.00 32.00 34.00
85 124. 84.122. 84.116. 84.116. 82.114. 80. 63. 63. 67. 60. 65. 97.24 96.57 94.57 93.24 91.24 78.12 76.86 77.72
69.60 74.10 40.00 38.00 32.00 34.00 34.00
86 126. 90.128. 86.119. 86.118. 86.118. 86. 82. 77. 68. 73. 70. 101.90 99.90 96.90 96.57 96.57 103.32 98.56 80.92
86.14 82.60 36.00 42.00 33.00 32.00 32.00
87 136. 80.130. 76.132. 84.134. 78.136. 76. 72. 75. 72. 65. 72. 98.57 93.91 99.90 96.57 95.90 97.92 97.50 95.04
87.10 97.92 56.00 54.00 48.00 56.00 60.00
88 122. 82.112. 78.110. 80.110. 82.110. 80. 60. 50. 60. 55. 70. 95.24 89.24 89.91 91.24 89.91 73.20 56.00 66.00
60.50 77.00 40.00 34.00 30.00 28.00 30.00
89 138. 90.136. 90.126. 90.126. 92.124. 94. 74. 68. 65. 68. 68. 105.89 105.23 101.90 103.23 103.90 102.12 92.48 81.90
85.68 84.32 48.00 46.00 36.00 34.00 30.00
90 128. 70.124. 72.122. 72.118. 74.122. 76. 63. 98. 87. 75. 65. 89.24 89.24 88.58 88.58 91.24 80.64 121.52 106.14

	88.50	79.30	58.00	52.00	50.00	44.00	46.00																		
91	130.	88.	128.	88.	126.	90.	126.	90.	124.	90.	63.	55.	53.	65.	63.	101.90	101.23	101.90	101.90	101.23	81.90	70.40	66.78		
	81.90	78.12	42.00	40.00	36.00	36.00	34.00																		
92	132.	76.	120.	80.	134.	90.	134.	90.	140.	82.	70.	77.	65.	55.	65.	94.57	93.24	104.56	104.56	101.23	92.40	92.40	87.10		
	73.70	91.00	56.00	40.00	44.00	44.00	58.00																		
93	122.	56.	118.	60.	110.	60.	110.	68.	112.	70.	75.	52.	67.	50.	80.	77.92	79.25	76.59	81.92	83.92	91.50	61.36	73.70		
	55.00	89.60	66.00	58.00	50.00	42.00	42.00																		
94	110.	90.	118.	86.	130.	88.	128.	86.	126.	80.	112.	110.	105.	100.	103.	96.57	96.57	101.90	99.90	95.24	123.20	129.80	136.50		
	128.00	129.78	20.00	32.00	42.00	42.00	46.00																		
95	110.	70.	108.	68.	108.	70.	104.	68.	104.	70.	70.	70.	60.	60.	67.	83.25	81.25	82.58	79.92	81.25	77.00	75.60	64.80		
	62.40	69.68	40.00	40.00	38.00	36.00	34.00																		
96	138.	84.	134.	80.	134.	80.	136.	80.	136.	80.	64.	60.	53.	56.	53.	101.90	97.90	97.90	98.57	98.57	88.32	80.40	71.02		
	76.16	72.08	54.00	54.00	54.00	56.00	56.00																		
97	130.	90.	124.	88.	124.	88.	118.	80.	120.	84.	83.	82.	73.	73.	72.	103.23	99.80	99.90	92.57	95.90	107.90	101.68	90.52		
	86.14	86.40	40.00	36.00	36.00	38.00	36.00																		
98	122.	90.	122.	90.	124.	90.	112.	90.	118.	90.	90.	83.	82.	85.	87.	100.57	100.57	101.23	97.24	99.23	109.80	101.26	101.68		
	95.20	102.66	32.00	32.00	34.00	22.00	28.00																		
99	132.	86.	126.	80.	124.	80.	120.	88.	118.	90.	65.	60.	55.	59.	62.	101.23	95.24	94.57	98.57	99.23	85.80	75.60	68.20		
	70.80	73.16	46.00	46.00	44.00	32.00	28.00																		
100	156.	98.	148.	90.	138.	88.	138.	88.	138.	84.	62.	53.	55.	55.	52.	117.22	109.22	104.56	104.56	101.90	96.72	78.44	75.90		
	75.90	71.76	58.00	58.00	50.00	50.00	54.00																		
101	138.	98.	130.	98.	130.	90.	120.	90.	120.	92.	77.	76.	75.	74.	85.	111.22	108.56	103.23	99.80	101.23	106.26	98.80	97.50		
	88.80	102.00	40.00	32.00	40.00	30.00	28.00																		
102	130.	76.	128.	74.	126.	70.	127.	70.	122.	72.	55.	54.	57.	60.	58.	93.91	91.91	88.58	88.91	88.58	71.50	69.12	71.82		
	76.20	70.76	54.00	54.00	56.00	57.00	50.00																		
103	122.	84.	120.	80.	124.	82.	124.	80.	122.	82.	86.	79.	75.	80.	78.	96.57	93.24	95.90	94.57	95.24	104.92	94.80	93.00		
	98.20	95.16	38.00	40.00	42.00	44.00	40.00																		
104	152.	110.	154.	110.	144.	98.	146.	96.	140.	96.	72.	65.	58.	75.	58.	123.88	124.54	111.89	112.55	110.56	109.44	100.10	83.52		
	109.50	81.20	42.00	44.00	48.00	50.00	44.00																		
105	132.	98.	138.	100.	130.	100.	130.	98.	130.	94.	78.	77.	65.	72.	63.	109.22	112.55	109.89	108.56	105.89	102.96	108.26	84.50		
	93.60	81.90	34.00	38.00	30.00	32.00	36.00																		
106	112.	80.	110.	72.	104.	72.	102.	76.	102.	74.	67.	61.	62.	66.	60.	90.58	84.58	82.58	84.58	83.25	75.04	67.10	64.48		
	67.32	61.20	32.00	38.00	32.00	26.00	28.00																		
107	150.	80.	142.	82.	140.	86.	138.	86.	130.	80.	85.	75.	67.	70.	72.	103.23	101.90	103.90	103.23	96.57	127.50	106.50	93.80		
	96.50	93.60	70.00	60.00	54.00	52.00	50.00																		
108	124.	80.	120.	82.	122.	80.	120.	78.	118.	84.	53.	53.	43.	52.	56.	94.57	94.57	93.91	91.91	95.24	65.72	63.60	52.46		
	62.40	66.08	44.00	38.00	42.00	42.00	34.00																		
109	130.	80.	128.	84.	120.	80.	118.	80.	118.	84.	72.	72.	68.	74.	62.	96.57	96.57	93.24	92.57	95.24	93.60	92.16	81.60		
	87.32	73.16	50.00	44.00	40.00	38.00	34.00																		
110	128.	88.	120.	80.	120.	84.	118.	84.	120.	84.	75.	74.	71.	73.	75.	101.23	93.24	95.90	95.24	95.90	96.00	88.80	85.20		
	86.14	90.00	40.00	40.00	36.00	34.00	36.00																		
111	130.	88.	130.	80.	122.	74.	120.	76.	120.	76.	55.	55.	58.	70.	65.	101.90	96.57	89.91	90.58	90.58	71.50	71.50	70.76		
	84.00	78.00	42.00	50.00	48.00	44.00	44.00																		
112	120.	80.	120.	84.	118.	84.	118.	86.	118.	82.	85.	55.	57.	68.	50.	93.24	95.90	95.24	96.57	93.91	102.00	66.00	67.26		
	80.24	59.00	40.00	36.00	34.00	32.00	36.00																		
113	126.	98.	126.	90.	130.	92.	130.	90.	132.	92.	77.	73.	70.	68.	65.	107.23	101.90	104.56	103.23	105.23	97.02	91.98	91.00		
	88.40	85.80	28.00	36.00	38.00	40.00	40.00																		
114	130.	80.	116.	74.	116.	74.	116.	76.	114.	70.	70.	83.	60.	80.	73.	96.57	87.91	87.91	89.24	84.58	91.00	96.28	69.60		
	92.80	83.22	50.00	42.00	42.00	40.00	44.00																		
115	132.	78.	130.	82.	132.	80.	132.	90.	130.	90.	87.	83.	65.	53.	55.	95.90	97.90	97.24	103.90	103.23	114.84	107.90	85.80		
	69.96	71.50	54.00	48.00	52.00	42.00	40.00																		
116	124.	84.	124.	86.	122.	84.	120.	86.	122.	76.	62.	52.	50.	57.	48.	97.24	98.57	96.57	97.24	91.24	76.88	64.48	61.00		
	68.40	58.56	40.00	38.00	38.00	34.00	46.00																		
117	120.	64.	110.	64.	112.	66.	110.	68.	112.	70.	64.	60.	50.	50.	50.	82.58	79.25	81.25	81.92	83.92	76.80	66.00	56.00		
	55.00	56.00	56.00	46.00	46.00	42.00	42.00																		
118	124.	80.	128.	76.	128.	74.	124.	76.	128.	78.	115.	120.	100.	120.	100.	94.57	93.24	91.91	91.91	94.57	142.60	153.60	128.00		
	148.80	128.00	44.00	52.00	54.00	48.00	50.00																		
119	100.	68.	104.	70.	100.	68.	100.	68.	100.	70.	65.	65.	60.	72.	65.	78.59	81.25	78.59	78.59	79.92	65.00	67.60	60.00		
	72.00	65.00	32.00	34.00	32.00	32.00	30.00																		
120	138.	82.	132.	84.	134.	84.	134.	82.	130.	82.	55.	50.	55.	55.	55.	100.57	99.90	100.57	99.23	97.90	75.90	66.00	73.70		
	73.70	71.50	56.00	48.00	50.00	52.00	48.00																		

16. Raw data for isometric rest-hamstrings
    (a) mean blood pressure (V16-V20)
    (b) modified tension time index (V21-V25)
    (c) pulse pressure (V26-V30)

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	74.80	74.80	40.00	34.00	32.00	30.00	30.00															
61	120.	78.	114.	84.	114.	80.	112.	80.	110.	80.	67.	68.	68.	74.	68.	91.91	93.91	91.24	90.58	89.91	80.40	77.52	77.52
	82.88	74.80	42.00	30.00	34.00	32.00	30.00															
62	124.	82.	122.	88.	120.	84.	118.	86.	122.	88.	74.	70.	75.	78.	75.	95.90	99.23	95.90	96.57	99.23	91.76	85.40	90.00
	92.04	91.50	42.00	34.00	36.00	32.00	34.00															
63	140.	72.	136.	72.	136.	72.	124.	70.	132.	70.	65.	57.	59.	68.	78.	94.57	93.24	93.24	87.91	90.58	91.00	77.52	80.24
	84.32	102.96	68.00	64.00	64.00	54.00	62.00															
64	124.	86.	124.	80.	120.	78.	118.	80.	120.	78.	50.	58.	51.	54.	55.	98.57	94.57	91.91	92.57	91.91	62.00	71.92	61.20
	63.72	66.00	38.00	44.00	42.00	38.00	42.00															
65	140.	96.	132.	96.	130.	100.	130.	100.	132.	100.	70.	69.	70.	67.	70.	110.56	107.89	109.89	109.89	110.56	98.00	91.08	91.00
	87.10	82.40	44.00	36.00	30.00	30.00	32.00															
66	140.	74.	120.	76.	116.	76.	118.	74.	118.	80.	68.	73.	68.	80.	64.	85.90	90.58	89.24	88.58	92.57	95.20	87.60	78.88
	94.40	75.52	66.00	44.00	40.00	44.00	38.00															
67	148.	90.	140.	86.	136.	88.	132.	88.	132.	86.	58.	56.	53.	60.	53.	109.22	103.90	103.90	102.56	101.23	85.84	78.40	72.08
	79.20	69.96	58.00	54.00	48.00	44.00	46.00															
68	124.	76.	122.	88.	120.	84.	118.	84.	118.	86.	65.	57.	50.	58.	63.	91.91	99.23	95.90	95.24	96.57	80.60	69.54	60.00
	68.44	74.34	48.00	34.00	36.00	34.00	32.00															
69	120.	58.	110.	66.	110.	68.	110.	60.	112.	66.	60.	65.	58.	56.	48.	78.58	80.59	81.92	76.58	81.25	72.00	71.50	63.80
	61.60	53.76	62.00	44.00	42.00	50.00	46.00															
70	118.	74.	122.	76.	118.	76.	118.	70.	112.	68.	97.	107.	80.	87.	95.	88.58	91.24	89.91	85.91	82.58	114.46	130.54	94.40
	102.66	106.40	44.00	46.00	42.00	48.00	44.00															
71	108.	70.	104.	70.	104.	68.	104.	70.	104.	68.	65.	65.	60.	68.	65.	82.58	81.25	79.92	81.25	79.92	70.20	67.60	62.40
	70.72	67.60	38.00	34.00	36.00	34.00	36.00															
72	140.	86.	146.	82.	132.	80.	134.	78.	136.	82.	57.	50.	58.	52.	75.	103.90	103.23	97.24	96.57	99.90	79.80	73.00	76.56
	69.68	102.00	54.00	64.00	52.00	56.00	54.00															
73	126.	108.	120.	90.	120.	88.	122.	96.	120.	92.	82.	74.	80.	77.	82.	113.89	99.90	98.57	104.56	101.23	103.32	88.80	96.00
	93.94	98.40	18.00	30.00	32.00	26.00	28.00															
74	110.	90.	110.	88.	112.	92.	108.	90.	112.	90.	83.	82.	83.	92.	88.	96.57	95.24	98.57	95.90	97.24	91.30	90.20	92.96
	99.36	98.56	20.00	22.00	20.00	18.00	22.00															
75	130.	88.	120.	90.	126.	88.	130.	88.	120.	90.	67.	52.	56.	46.	85.	101.90	99.90	100.57	98.57	99.90	113.10	62.40	70.56
	55.20	102.00	42.00	30.00	38.00	32.00	30.00															
76	130.	94.	130.	90.	128.	88.	130.	88.	128.	90.	58.	57.	60.	55.	55.	105.89	103.23	101.23	101.90	102.56	75.40	74.10	76.80
	71.50	70.40	36.00	40.00	40.00	42.00	38.00															
77	130.	90.	120.	92.	120.	90.	118.	88.	122.	88.	78.	73.	80.	75.	75.	103.23	101.23	98.90	97.90	99.23	101.40	87.60	96.00
	88.50	91.50	40.00	28.00	30.00	30.00	34.00															
78	128.	76.	110.	78.	118.	80.	120.	76.	112.	84.	55.	53.	53.	52.	59.	93.24	88.58	92.57	90.58	93.24	70.40	58.30	62.54
	62.40	66.08	52.00	32.00	38.00	44.00	28.00															
79	118.	88.	118.	80.	118.	90.	118.	86.	120.	78.	93.	64.	78.	70.	77.	97.90	92.57	99.23	96.57	97.91	109.74	75.52	92.04
	82.60	92.40	30.00	38.00	28.00	32.00	42.00															
80	148.	104.	138.	100.	138.	98.	140.	92.	140.	100.	67.	58.	58.	58.	70.	116.55	112.55	111.22	107.89	113.22	99.16	80.04	80.04
	81.20	88.00	44.00	38.00	40.00	48.00	40.00															
81	132.	100.	130.	96.	130.	96.	128.	98.	130.	98.	67.	66.	73.	65.	65.	110.56	107.23	107.23	107.89	108.56	88.44	85.80	94.90
	83.20	84.50	32.00	34.00	34.00	30.00	32.00															
82	112.	84.	110.	76.	112.	80.	110.	80.	110.	80.	66.	67.	57.	72.	68.	93.24	87.25	90.58	89.91	89.91	73.92	73.70	63.84
	79.20	74.80	28.00	34.00	32.00	30.00	30.00															
83	140.	84.	140.	80.	140.	78.	132.	78.	134.	80.	53.	52.	53.	54.	58.	102.56	99.90	98.57	95.90	97.90	74.20	72.80	74.20
	71.28	77.72	56.00	60.00	62.00	54.00	54.00															
84	118.	80.	120.	82.	118.	84.	118.	80.	118.	84.	62.	62.	53.	54.	57.	92.57	94.57	95.24	92.57	95.24	73.16	74.40	62.54
	63.72	67.26	38.00	38.00	34.00	38.00	34.00															
85	124.	86.	120.	86.	118.	84.	114.	84.	112.	84.	77.	60.	65.	68.	68.	98.57	97.24	95.24	93.91	93.24	95.48	72.00	76.70
	77.52	76.16	38.00	34.00	34.00	30.00	28.00															
86	118.	88.	118.	92.	118.	90.	118.	88.	118.	90.	67.	62.	62.	67.	68.	97.90	100.57	99.23	97.90	99.23	78.06	73.16	73.16
	79.06	80.24	30.00	26.00	28.00	30.00	28.00															
87	136.	78.	120.	78.	120.	78.	126.	76.	120.	72.	84.	52.	70.	65.	80.	97.24	91.91	91.91	92.57	87.91	114.24	62.40	84.00
	81.90	96.00	58.00	42.00	42.00	50.00	48.00															
88	112.	76.	110.	76.	112.	80.	112.	80.	112.	80.	47.	51.	52.	58.	60.	87.91	87.25	90.58	90.58	90.58	52.64	56.10	58.24
	64.96	67.20	36.00	34.00	32.00	32.00	32.00															
89	132.	100.	124.	100.	122.	100.	126.	100.	130.	100	70.	78.	75.	77.	68.	110.56	107.89	107.23	108.56	108.89	92.40	86.72	91.90
	97.02	88.40	32.00	24.00	22.00	26.00	30.00															
90	118.	80.	118.	80.	120.	76.	114	78.	118.	78.	63.	56.	60.	57.	60.	92.57	92.57	90.58	89.91	91.24	74.34	66.08	72.00

| | | |

17. Raw data for isometric exercise-quadriceps
    (a) mean blood pressure (V13-V16)
    (b) modified tension time index (V17-V20)
    (c) pulse pressure (V21-V24)

| | | |

18. Raw data for isometric exercise-hamstrings
    (a) mean blood pressure (V13-V16)
    (b) modified tension time index (V17-V20)
    (c) pulse pressure (V21-V24)

| | | |

19. Raw data for comparison of isokinetic and isometric exercise-heart rate

1	104	61	125
2	145	62	140
3	132	63	137
4	130	64	150
5	137	65	155
6	110	66	183
7	115	67	133
8	113	68	115
9	135	69	147
10	118	70	177
11	120	71	158
12	135	72	186
13	90	73	110
14	108	74	132
15	136	75	80
16	140	76	107
17	135	77	113
18	162	78	140
19	125	79	150
20	100	80	101
21	143	81	112
22	165	82	95
23	130	83	132
24	163	84	108
25	115	85	115
26	153	86	113
27	140	87	133
28	135	88	117
29	140	89	90
30	137	90	160
31	115	91	125
32	150	92	115
33	132	93	133
34	128	94	174
35	134	95	90
36	116	96	140
37	130	97	100
38	142	98	124
39	145	99	82
40	143	100	108
41	138	101	135
42	193	102	135
43	123	103	150
44	125	104	115
45	150	105	105
46	175	106	98
47	165	107	108
48	180	108	124
49	112	109	93
50	153	110	87
51	138	111	150
52	120	112	124
53	150	113	80
54	130	114	130
55	135	115	125
56	135	116	103
57	127	117	117
58	135	118	155
59	142	119	94
60	144	120	116

20. Raw data for comparison of isokinetic and isometric exercise-systolic blood pressure

1	210	61	160
2	164	62	168
3	210	63	176
4	198	64	170
5	160	65	192
6	170	66	144
7	190	67	158
8	160	68	146
9	150	69	190
10	198	70	170
11	188	71	192
12	190	72	162
13	168	73	140
14	164	74	134
15	192	75	168
16	205	76	180
17	188	77	160
18	160	78	184
19	148	79	150
20	140	80	170
21	170	81	162
22	162	82	150
23	162	83	190
24	140	84	150
25	180	85	150
26	180	86	152
27	180	87	160
28	190	88	160
29	180	89	154
30	190	90	160
31	170	91	172
32	170	92	210
33	170	93	150
34	156	94	152
35	180	95	132
36	168	96	172
37	158	97	140
38	150	98	148
39	192	99	162
40	170	100	170
41	199	101	150
42	158	102	180
43	146	103	140
44	142	104	180
45	182	105	155
46	140	106	142
47	196	107	168
48	155	108	148
49	150	109	168
50	170	110	148
51	210	111	190
52	190	112	156
53	170	113	160
54	180	114	170
55	180	115	170
56	180	116	152
57	170	117	178
58	152	118	150
59	168	119	142
60	160	120	170

21. Raw data for comparison of isokinetic and isometric exercise - diastolic blood pressure

1	66	61	38
2	54	62	55
3	68	63	20
4	10	64	60
5	48	65	40
6	60	66	40
7	60	67	35
8	64	68	58
9	68	69	24
10	56	70	10
11	58	71	15
12	50	72	10
13	54	73	110
14	70	74	110
15	20	75	110
16	72	76	138
17	54	77	110
18	54	78	110
19	40	79	110
20	52	80	130
21	15	81	120
22	40	82	118
23	55	83	130
24	25	84	98
25	56	85	94
26	58	86	104
27	76	87	110
28	25	88	124
29	62	89	120
30	68	90	120
31	50	91	124
32	68	92	140
33	62	93	116
34	64	94	90
35	45	95	100
36	72	96	130
37	25	97	110
38	48	98	120
39	20	99	112
40	50	100	138
41	55	101	120
42	25	102	110
43	45	103	115
44	50	104	118
45	20	105	112
46	30	106	92
47	5	107	110
48	10	108	114
49	60	109	120
50	72	110	102
51	55	111	138
52	30	112	130
53	45	113	128
54	60	114	92
55	44	115	122
56	62	116	120
57	76	117	110
58	68	118	100
59	48	119	110
60	38	120	130

22. Raw data for comparison of isokinetic and isometric exercise - mean blood pressure

1	113.89
2	90.58
3	115.22
4	72.59
5	85.25
6	96.57
7	103.23
8	95.90
9	95.24
10	103.23
11	101.23
12	96.57
13	91.91
14	101.23
15	77.26
16	116.22
17	98.57
18	89.24
19	75.92
20	81.25
21	66.60
22	80.59
23	90.58
24	63.27
25	97.24
26	98.57
27	110.56
28	79.92
29	101.23
30	108.56
31	89.91
32	101.90
33	97.90
34	94.57
35	89.91
36	103.90
37	69.26
38	81.92
39	77.26
40	89.91
41	102.90
	69.26
	78.59
4	80.59
5	73.93
46	66.60
47	68.60
48	58.27
49	89.91
50	104.56
51	106.56
52	83.25
53	86.58
54	99.90
55	89.24
56	101.23
57	107.23
58	95.90
59	87.91
60	78.59
61	78.59
62	92.57
63	71.93
64	96.57
65	90.58
66	74.59
67	75.92
68	87.25
69	79.25
70	63.27
71	73.93
72	60.61
73	119.88
74	117.88
75	129.20
76	151.85
77	126.54
78	134.53
79	123.21
80	143.19
81	133.87
82	128.54
83	149.85
84	115.22
85	112.55
86	119.88
87	126.54
88	135.86
89	131.20
90	133.20
91	139.86
92	163.17
93	127.21
94	110.56
95	110.56
96	143.86
97	119.88
98	129.20
99	128.54
100	148.52
101	129.87
102	133.20
103	123.21
104	138.53
105	126.21
106	108.56
107	129.20
108	125.21
109	135.86
110	117.22
111	155.18
112	138.53
113	138.53
114	117.88
115	137.86
116	130.54
117	132.53
118	116.55
119	120.55
120	143.19

23. Raw data for comparison of isokinetic and isometric exercise - modified tension time index

1	218.40	61	200.00
2	237.80	62	235.20
3	277.20	63	241.10
4	257.40	64	255.00
5	219.20	65	297.60
6	187.00	66	263.50
7	218.50	67	210.10
8	180.80	68	167.90
9	202.50	69	279.30
10	233.60	70	300.90
11	225.60	71	303.30
12	256.50	72	301.30
13	151.20	73	154.00
14	177.10	74	176.88
15	261.10	75	134.40
16	287.00	76	192.60
17	253.80	77	180.80
18	259.20	78	257.60
19	185.00	79	225.00
20	140.00	80	171.70
21	243.10	81	181.44
22	267.30	82	142.50
23	210.60	83	250.80
24	228.20	84	162.00
25	207.00	85	172.50
26	275.40	86	171.76
27	252.00	87	212.80
28	256.50	88	187.20
29	252.00	89	138.60
30	260.30	90	256.00
31	195.50	91	215.00
32	255.00	92	241.50
33	224.40	93	199.50
34	199.60	94	264.48
35	241.20	95	118.80
36	194.80	96	240.80
37	205.40	97	140.00
38	213.00	98	183.52
39	278.40	99	132.84
40	243.10	100	183.60
41	274.60	101	202.50
42	304.90	102	243.00
43	179.50	103	210.00
44	177.50	104	207.00
45	273.00	105	162.75
46	245.00	106	139.16
47	323.40	107	181.44
48	279.00	108	183.52
49	168.00	109	156.24
50	260.10	110	128.76
51	289.80	111	285.00
52	228.00	112	193.44
53	255.00	113	128.00
54	234.00	114	221.00
55	243.00	115	212.50
56	243.00	116	156.56
57	215.90	117	208.26
58	205.20	118	232.50
59	238.50	119	133.48
60	230.40	120	197.20

24. Raw data for comparison of isokinetic and isometric exercise - pulse pressure

122.00	144.00
113.00	110.00
156.00	142.00
110.00	188.00
152.00	112.00
104.00	110.00
123.00	130.00
88.00	96.00
166.00	82.00
160.00	142.00
177.00	130.00
152.00	140.00
30.00	114.00
24.00	94.00
58.00	172.00
42.00	133.00
50.00	134.00
74.00	106.00
40.00	108.00
40.00	88.00
42.00	155.00
32.00	122.00
60.00	107.00
52.00	115.00
56.00	124.00
48.00	122.00
50.00	104.00
36.00	165.00
34.00	118.00
40.00	122.00
48.00	120.00
70.00	102.00
34.00	108.00
62.00	92.00
32.00	135.00
42.00	96.00
30.00	133.00
28.00	102.00
50.00	172.00
32.00	120.00
30.00	144.00
70.00	133.00
25.00	101.00
62.00	92.00
43.00	162.00
50.00	110.00
58.00	191.00
34.00	145.00
48.00	90.00
46.00	98.00
52.00	155.00
26.00	160.00
32.00	125.00
78.00	120.00
48.00	136.00
32.00	118.00
68.00	94.00
50.00	84.00
32.00	120.00
40.00	122.00

APPENDIX M

Format Statements

1. Format statement for calculation of isokinetic rest-heart rate

```
RUN NAME        ISOKRESTHR SCORES
FILE NAME       ISOKRESTHR
VARIABLE LIST   VAR1 TO VAR54
INPUT FORMAT    FIXED(2(18F3.0/)(18F3.0))
INPUT MEDIUM    DISK
N OF CASES      24
ANOVAR          WLABELS=SPEED(LOW,MED,HI) BY
                REST(R1,R2,R3,R4,R5,R6) BY
                TRIALS(T1,T2,T3)/
                 MEASURES=VAR1 TO VAR54
STATISTICS      ALL
READ INPUT DATA
FINISH
```

2. Format statement for calculation of isokinetic rest-blood pressure

(a) systolic

```
RUN NAME          ISOKRESTBP SCORES
FILE NAME         ISOKRESTBP
VARIABLE LIST     V1 TO V108
INPUT FORMAT      FIXED(5(18F3.0/)(18F3.0))
INPUT MEDIUM      DISK
TASK NAME         SYSTOLIC
ANOVAR            WLABELS=SPEED(LOW,MED,HI) BY
                  REST(1,2,3,4,5,6) BY
                  TRIALS(1,2,3)/
                  MEASURES=V1 V3 V5 V7 V9 V11 V13
                  V15 V17 V19 V21 V23 V25 V27 V29
                  V31 V33 V35 V37 V39 V41 V43 V45
                  V47 V49 V51 V53 V55 V57 V59 V61
                  V63 V65 V67 V69 V71 V73 V75 V77
                  V79 V81 V83 V85 V87 V89 V91 V93
                  V95 V97 V99 V101 V103 V105 V107
STATISTICS         ALL
READ INPUT DATA
FINISH
```

(b) diastolic

```
RUN NAME          ISOKRESTBP SCORES
FILE NAME         ISOKRESTBP
VARIABLE LIST     V1 TO V108
INPUT FORMAT      FIXED(5(18F3.0/)(18F3.0))
INPUT MEDIUM      DISK
TASK NAME         DIASTOLIC
ANOVAR            WLABELS=SPEED(LOW,MED,HI) BY
                  REST(1,2,3,4,5,6) BY
                  TRIALS(1,2,3)/
                  MEASURES= V2 V4 V6 V8 V10 V12 V14 V16
                  V18 V20 V22 V24 V26 V28 V30 V32 V34
                  V36 V38 V40 V42 V44 V46 V48 V50 V52
                  V54 V56 V58 V60 V62 V64 V66 V68 V70
                  V72 V74 V76 V78 V80 V82 V84 V86 V88
                  V90 V92 V94 V96 V98 V100 V102
                  V104 V106 V108
STATISTICS         ALL
READ INPUT DATA
FINISH
```

3. Format statement for calculation of isokinetic exercise-heart rate

```
RUN NAME         ISO SCORES
FILE NAME        ISOKEXHR
VARIABLE LIST    VAR1 TO VAR12
INPUT FORMAT     FIXED(12F3.0)
INPUT MEDIUM     DISK
N OF CASES       24
ANOVAR           WLABELS=SPEED(LOW, MED,HI) BY TRIAL(T1,T2,T3,T4)/
                 MEASURES=VAR1 TO VAR12
OPTIONS          1
STATISTICS       ALL
READ INPUT DATA
FINISH
```

4. Format statement for calculation of isokinetic exercise-blood pressure-systolic and diastolic

```
RUN NAME         ISOKEXBP SCORES
FILE NAME        ISOKEXBP
VARIABLE LIST    V1 TO V24
INPUT FORMAT     FIXED(12(F3.0,F2.0))
INPUT MEDIUM     DISK
TASK NAME        SYSTOLIC
ANOVAR           WLABELS=SPEED(LOW,MED,HI) BY
                 TRIALS(T1,T2,T3,T4)/
                 MEASURES=V1 V3 V5 V7 V9 V11 V13 V15 V17 V19 V21 V23
STATISTICS       ALL
TASK NAME        DIASTOLIC
ANOVAR           WLABELS=SPEED(LOW,MED,HI) BY
                 TRIALS(T1,T2,T3,T4)/
                 MEASURES=V2 V4 V6 V8 V10 V12 V14 V16 V18 V20 V22 V24
STATISTICS       ALL
FINISH
```

5. Format statement for calculation of isometric rest-quadriceps-heart rate

```
RUN NAME          ISOMRESTQDHR SCORES
FILE NAME         ISOMRESTQDHR
VARIABLE LIST     V1 TO V5
INPUT FORMAT      FIXED(5F3.0)
INPUT MEDIUM      DISK
IF                (SEQNUM LE 24) GROUPS=1
IF                (SEQNUM GE 25 AND SEQNUM LE 48) GROUPS=2
IF                (SEQNUM GE 49 AND SEQNUM LE 72) GROUPS=3
IF                (SEQNUM GE 73 AND SEQNUM LE 96) GROUPS=4
IF                (SEQNUM GE 97 AND SEQNUM LE 120) GROUPS=5
TASK NAME         HEART RATE
ANOVAR            BGROUPS=GROUPS(5)/
                  WLABELS=TRIALS(1,2,3,4,5)/
                 MEASURES=V1 TO V5
STATISTICS        ALL
FINISH
```

6. Format statement for calculation of isometric rest-quadriceps-blood pressure

(a) systolic

```
RUN NAME          ISOMRESTQDBP SCORES
FILE NAME         DATAISOMREST
VARIABLE LIST     V1 TO V10
INPUT FORMAT      FIXED(10F3.0)
INPUT MEDIUM      DISK
IF                (SEQNUM LE 24) GROUPS=1
IF                (SEQNUM GE 25 AND SEQNUM LE 48) GROUPS=2
IF                (SEQNUM GE 49 AND SEQNUM LE 72) GROUPS=3
IF                (SEQNUM GE 73 AND SEQNUM LE 96) GROUPS=4
IF                (SEQNUM GE 97 AND SEQNUM LE 120) GROUPS=5
TASK NAME         SYSTOLIC
ANOVAR            BGROUPS=GROUPS(5)/
                  WLABELS=TRIALS(1,2,3,4,5)/
                  MEASURES=V1 V3 V5 V7 V9
STATISTICS        ALL
FINISH
```

(b) diastolic

```
RUN NAME          ISOMRESTQDBP SCORES
FILE NAME         DATAISOMREST
VARIABLE LIST     V1 TO V10
INPUT FORMAT      FIXED(10F3.0)
INPUT MEDIUM      DISK
IF                (SEQNUM LE 24) GROUPS=1
IF                (SEQNUM GE 25 AND SEQNUM LE 48) GROUPS=2
IF                (SEQNUM GE 49 AND SEQNUM LE 72) GROUPS=3
IF                (SEQNUM GE 73 AND SEQNUM LE 96) GROUPS=4
IF                (SEQNUM GE 97 AND SEQNUM LE 120) GROUPS=5
TASK NAME         DIASTOLIC
ANOVAR            BGROUPS=GROUPS(5)/
                  WLABELS=TRIALS(1,2,3,4,5)/
                  MEASURES=V2 V4 V6 V8 V10
STATISTICS        ALL
FINISH
```

7. Format statement for calculation of isometric rest-hamstrings-heart rate

```
RUN NAME          ISOMRESTHMHR SCORES
FILE NAME         ISOMRESTHMHR
VARIABLE LIST     V1 TO V5
INPUT FORMAT      FIXED(5F3.0)
INPUT MEDIUM      DISK
IF                (SEQNUM LE 24) GROUPS=1
IF                (SEQNUM GE 25 AND SEQNUM LE 48) GROUPS=2
IF                (SEQNUM GE 49 AND SEQNUM LE 72) GROUPS=3
IF                (SEQNUM GE 73 AND SEQNUM LE 96) GROUPS=4
IF                (SEQNUM GE 97 AND SEQNUM LE 120) GROUPS=5
TASK NAME         HEART RATE
ANOVAR            BGROUPS=GROUPS(5)/
                  WLABELS=TRIALS(1,2,3,4,5)/
                  MEASURES=V1 TO V5
STATISTICS        ALL
FINISH
```

8. Format statement for calculation of isometric rest-hamstrings-blood pressure

(a) systolic

```
RUN NAME        ISOMRESTHMBP SCORES
FILE NAME       ISOMRESTHMBP
VARIABLE LIST    V1 TO V10
INPUT FORMAT    FIXED(10F3.0)
INPUT MEDIUM    DISK
IF               (SEQNUM LE 24) GROUPS=1
IF               (SEQNUM GE 25 AND SEQNUM LE 48) GROUPS=2
IF               (SEQNUM GE 49 AND SEQNUM LE 72) GROUPS=3
IF               (SEQNUM GE 73 AND SEQNUM LE 96) GROUPS=4
IF               (SEQNUM GE 97 AND SEQNUM LE 120) GROUPS=5
TASK NAME       SYSTOLIC
ANOVAR           BGROUPS=GROUPS(5)/
                WLABELS=TRIALS(1,2,3,4,5)/
                MEASURES=V1 V3 V5 V7 V9
STATISTICS      ALL
FINISH
```

(b) diastolic

```
RUN NAME        ISOMRESTHMBP SCORES
FILE NAME       ISOMRESTHMBP
VARIABLE LIST    V1 TO V10
INPUT FORMAT    FIXED(10F3.0)
INPUT MEDIUM    DISK
IF              (SEQNUM LE 24) GROUPS=1
IF              (SEQNUM GE 25 AND SEQNUM LE 48) GROUPS=2
IF              (SEQNUM GE 49 AND SEQNUM LE 72) GROUPS=3
IF              (SEQNUM GE 73 AND SEQNUM LE 96) GROUPS=4
IF              (SEQNUM GE 97 AND SEQNUM LE 120) GROUPS=5
TASK NAME       DIASTOLIC
ANOVAR           BGROUPS=GROUPS(5)/
                WLABELS=TRIALS(1,2,3,4,5)/
                MEASURES=V2 V4 V6 V8 V10
STATISTICS      ALL
FINISH
```

9. Format statement for calculation of isometric exercise-quadriceps-heart rate

```
RUN NAME          ISOMEXQDHR SCORES
FILE NAME         ISOMEXQDHR
VARIABLE LIST     VAR1 TO VAR4
INPUT FORMAT      FIXED(4F3.0)
INPUT MEDIUM      DISK
N OF CASES        24
ANOVAR            WLABELS=TREATMENT(1,2,3,4)/
                  MEASURES=VAR1 TO VAR4
OPTIONS           1
STATISTICS        ALL
READ INPUT DATA
FINISH
```

10. Format statement for calculation of isometric exercise-quadriceps-blood pressure

(a) <u>systolic</u>

```
RUN NAME          ISOMEXQDBP SCORES
FILE NAME         ISOMEXQDBP
VARIABLE LIST     V1 TO V8
INPUT FORMAT      FIXED(8F3.0)
INPUT MEDIUM      DISK
TASK NAME         SYSTOLIC
ANOVAR            WLABELS=REST(1,2,3,4)/
                  MEASURES=V1 V3 V5 V7
STATISTICS        ALL
FINISH
```

(b) <u>diastolic</u>

```
RUN NAME          ISOMEXQDBP SCORES
FILE NAME         ISOMEXQDBP
VARIABLE LIST     V1 TO V8
INPUT FORMAT      FIXED(8F3.0)
INPUT MEDIUM      DISK
TASK NAME         DIASTOLIC
ANOVAR            WLABELS=REST(1,2,3,4)/
                  MEASURES=V2,V4,V6,V8
STATISTICS        ALL
READ INPUT DATA
FINISH
```

11. Format statement for calculation of isometric exercise-hamstrings-heart rate

```
RUN NAME          ISOMEXHMHR SCORES
FILE NAME         ISOMEXHMHR
VARIABLE LIST     VAR1 TO VAR4
INPUT FORMAT      FIXED(4F3.0)
INPUT MEDIUM      DISK
N OF CASES        24
ANOVAR            WLABELS=TREATMENT(1,2,3,4)/
                  MEASURES=VAR1 TO VAR4

OPTIONS           1
STATISTICS        ALL
READ INPUT DATA
FINISH
```

12. Format statement for calculation of isometric exercise-hamstrings-blood pressure

(a) <u>systolic</u>

```
RUN NAME          ISOMEXHMBP SCORES
FILE NAME         ISOMEXHMBP
VARIABLE LIST     V1 TO V8
INPUT FORMAT      FIXED(8F3.0)
INPUT MEDIUM      DISK
TASK NAME         SYSTOLIC
ANOVAR            WLABELS=REST(1,2,3,4)/
                  MEASURES=V1,V3,V5,V7

STATISTICS        ALL
READ INPUT DATA
FINISH
```

(b) <u>diastolic</u>

```
RUN NAME          ISOMEXHMBP SCORES
FILE NAME         ISOMEXHMBP
VARIABLE LIST     V1 TO V8
INPUT FORMAT      FIXED(8F3.0)
INPUT MEDIUM      DISK
TASK NAME         DIASTOLIC
ANOVAR            WLABELS=REST(1,2,3,4)/
                  MEASURES=V2,V4,V6,V8

STATISTICS        ALL
READ INPUT DATA
FINISH
```

13. Format statement for calculation of mean blood pressure, modified tension time index and pulse pressure from raw data

```
R FILE=ISOKEXBP FORMAT=(12(F3.0,F2.0)) VAR=1-24 CASES=1-24 L='
R FILE=ISOKEXHR FORMAT=12F3.0 VAR=25-36 CASES=1-24 L='
TRANS RESULT=101-112 FUNCTION=MULTIPLY VAR=1,3,5,7,9,11,13,15,17,19,21,23:0.333 CASES=ALL L='
TRANS RESULT=113-124 FUNCTION=MULTIPLY VAR=2,4,6,8,10,12,14,16,18,20,22,24:0.666 L='
TRANS RESULT=37-48 FUNCTION=ADD VAR=101-112:113-124 L='
TRANS RESULT=201-212 FUNCTION=MULTIPLY VAR=1,3,5,7,9,11,13,15,17,19,21,23:25-36 CASES=ALL L='
TRANS RESULT=49-60 FUNCTION=DIVIDE VAR=201-212:100.0 L='
TRANS RESULT=61-72 FUNCTION=SUBTRACT VAR=1,3,5,7,9,11,13,15,17,19,21,23:2,4,6,8,10,12,14,16,18,20,22,24 L='
WRITE FILE=-KEX FORMAT=36F4.0,36F7.2 VAR=1-72 CASES=ALL
```

14. Format statement for calculation of mean blood pressure, modified tension time index and pulse pressure form isokinetic rest

```
RUN NAME          ISOKREST SCORES
FILE NAME         ISOKREST
VARIABLE LIST     V1 TO V108
INPUT FORMAT      FIXED(27F4.0,27F7.2/27F4.0,27F7.2)
INPUT MEDIUM      DISK
TASK NAME         MEAN BLOOD PRESSURE ANALYSIS
ANOVAR            WLABELS=TRIALS(1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18)/
                  MEASURES=V28 V29 V30 V31 V32 V33 V34 V35 V36 V82 V83 V84 V85 V86 V87 V88 V89
                      V87 V88 V89 V90

STATISTICS        ALL
TASK NAME         MTTI ANALYSIS
ANOVAR             WLABELS=TRIALS(1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18)/
                  MEASURES=V37 V38 V39 V40 V41 V42 V43 V44 V45 V91 V92 V93 V94 V95 V96 V97 V98 V99
                      V96 V97 V98 V99

STATISTICS        ALL
TASK NAME         PULSE PRESSURE ANALYSIS
ANOVAR            WLABELS=TRIALS(1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18)/
                  MEASURES=V46 V47 V48 V49 V50 V51 V52 V53 V54 V100 V101 V102 V103 V104 V105 V106 V107 V108
                      V104 V105 V106 V107 V108

STATISTICS        ALL
FINISH
```

15. Format statement for calculation of mean blood pressure, modified tension time index and pulse pressure for isokinetic exercise

```
RUN NAME          ISOKEX SCORES
FILE NAME         ISOKEX
VARIABLE LIST     V1 TO V72
INPUT FORMAT      FIXED(36F4.0,36F7.2)
INPUT MEDIUM      DISK
TASK NAME         MEAN BLOOD PRESSURE ANALYSIS
ANOVAR             WLABELS=TRIALS(1,2,3,4,5,6,7,8,9,10,11,12)/
                  MEASURES=V37 V38 V39 V40 V41 V42 V43 V44 V45 V46 V47 V48
STATISTICS        ALL
TASK NAME         MTTI ANALYSIS
ANOVAR             WLABELS=TRIALS(1,2,3,4,5,6,7,8,9,10,11,12)/
                  MEASURES=V49 V50 V51 V52 V53 V54 V55 V56 V57 V58 V59 V60
STATISTICS        ALL
TASK NAME         PULSE PRESSURE ANALYSIS
ANOVAR             WLABELS=TRIALS(1,2,3,4,5,6,7,8,9,10,11,12)/
                  MEASURES=V61 V62 V63 V64 V65 V66 V67 V68 V69 V70 V71 V72
STATISTICS        ALL
FINISH
```

16. Format statement for calculation of mean blood pressure, modified tension time index and pulse pressure for isometric rest-quadriceps and isometric rest-hamstrings

```
RUN NAME          ISOMRESTHM SCORES
FILE NAME         ISOMRESTHM
VARIABLE LIST     V1 TO V30
INPUT FORMAT      FIXED(15F4.0,15F7.2)
INPUT MEDIUM      DISK
TASK NAME         MEAN BLOOD PRESSURE ANALYSIS
ANOVAR             WLABELS=TRIALS(1,2,3,4,5)/
                  MEASURES=V16 V17 V18 V19 V20
STATISTICS        ALL
TASK NAME         MTTI
ANOVAR             WLABELS=TRIALS(1,2,3,4,5)/
                  MEASURES=V21 V22 V23 V24 V25
STATISTICS        ALL
TASK NAME         PULSE PRESSURE ANALYSIS
ANOVAR             WLABELS=TRIALS(1,2,3,4,5)/
                  MEASURES=V26 V27 V28 V29 V30
STATISTICS        ALL
FINISH
```

17. Format statement for calculation of mean blood pressure, modified tension time index and pulse pressure for isometric exercise - quadriceps and isometric exercise-quadriceps

```
RUN NAME          ISOMEXHM SCORES
FILE NAME         ISOMEXHM
VARIABLE LIST     V1 TO V24
INPUT FORMAT      FIXED(12F4.0,12F7.2)
INPUT MEDIUM      DISK
TASK NAME         MEAN BLOOD PRESSURE ANALYSIS
ANOVAR            WLABELS=TRIALS(1,2,3,4)/
                  MEASURES=V13 V14 V15 V16
STATISTICS        ALL
TASK NAME         MTTI
ANOVAR            WLABELS=TRIALS(1,2,3,4)/
                  MEASURES=V17 V18 V19 V20
STATISTICS        ALL
TASK NAME         PULSE PRESSURE ANALYSIS
ANOVAR            WLABELS=TRIALS(1,2,3,4)/
                  MEASURES=V21 V22 V23 V24
STATISTICS        ALL
FINISH
```

18. Format statement for comparison of isokinetic and isometric exercise - heart rate

(a) statement to get raw data combination of maximum isokinetic exercise (first exercise bout) and maximum voluntary contraction in isometric exercise (using * midas)

```
READ FILE=ISOKEXHR FORMAT=3X,I3 VAR=1 LABEL=HEART1 CASES=1-24
READ FILE=ISOKEXHR FORMAT=15X,I3 VAR=1 LABEL=HEART2 CASES=25-48
READ FILE=ISOKEXHR FORMAT=27X,I3 VAR=1 LABEL=HEART3 CASES=49-72
READ FILE=ISOMEXQDHR FORMAT=I3 VAR=1 LABEL=HEART4 CASES=73-96
READ FILE=ISOMEXHMHR FORMAT=I3 VAR=1 LABEL=HEART5 CASES=97-120
WRITE FILE=HEART10 FORMAT=I3 VAR=1 CASES=ALL
FINISH
```

(b) statement to compare isokinetic and isometric exercise by one way analysis of variance (using * spss)

```
RUN NAME        COMHEART
FILE NAME       COMHEART
VARIABLE LIST   V1
INPUT FORMAT    FIXED(F3.0)
INPUT MEDIUM    DISK
SUBFILE LIST    HEART1(24),HEART2(24),HEART3(24),HEART4(24),HEART5(24)
ONEWAY          V1 BY SUBFILES/RANGES=SCHEFFE/
STATISTICS      ALL
FINISH
```

19. Format statement for comparison of isokinetic and isometric exercise - systolic blood pressure

(a) statement to get raw data combination of maximum isokinetic exercise (first exercise bout) and maximum voluntary contraction in isometric exercise (using * midas)

```
READ FILE=ISOKEXBP FORMAT=5X,I3 VAR=1 LABEL=SYSTOLIC1 CASES=1-24
READ FILE=ISOKEXBP FORMAT=25X,I3 VAR=1 LABEL=SYSTOLIC2 CASES=25-48
READ FILE=ISOKEXBP FORMAT=45X,I3 VAR=1 LABEL=SYSTOLIC3 CASES=49-72
READ FILE=ISOMEXQ08P FORMAT=I3 VAR=1 LABEL=SYSTOLIC4 CASES=73-96
READ FILE=ISOMEXHM8P FORMAT=I3 VAR=1 LABEL=SYSTOLIC5 CASES=97-120
WRITE FILE=SYSTOLIC10 FORMAT=I3 VAR=1 CASES=ALL
FINISH
```

(b) statement to compare isokinetic and isometric exercise by one way analyses of variance (using * spss)

```
RUN NAME        COMSYSTOLIC
FILE NAME       COMSYSTOLIC
VARIABLE LIST   V1
INPUT FORMAT    FIXED(F3.0)
INPUT MEDIUM    DISK
SUBFILE LIST    SYSTOL1(24),SYSTOL2(24),SYSTOL3(24),SYSTOL4(24),SYSTOL5(24)
ONEWAY          V1 BY SUBFILES/RANGES=SCHEFFE/
STATISTICS      ALL
FINISH
```

20. Format statement for comparison of isokinetic and isometric exercise - diastolic blood pressure

(a) statement to get raw data combination of maximum isokinetic exercise (first exercise bout) and maximum voluntary contraction in isometric exercise (using * midas)

```
READ FILE=ISOKEXBP FORMAT=8X,I2 VAR=1 LABEL=DIASTOLIC1 CASES=1-24
READ FILE=ISOKEXBP FORMAT=28X,I2 VAR=1 LABEL=DIASTOLIC2 CASES=25-48
READ FILE=ISOKEXBP FORMAT=48X,I2 VAR=1 LABEL=DIASTOLIC3 CASES=49-72
READ FILE=ISOMEXQDBP FORMAT=3X,I3 VAR=1 LABEL=DIASTOLIC4 CASES=73-96
READ FILE=ISOMEXHMBP FORMAT=3X,I3 VAR=1 LABEL=DIASTOLIC5 CASES=97-120
WRITE FILE=DIASTOLIC10 FORMAT=I3 VAR=1 CASES=ALL
```

(b) statement to compare isokinetic and isometric exercise by one way analyses of variance (using * spss)

```
RUN NAME        COMDIASTOLIC
FILE NAME       COMDIASTOLIC
VARIABLE LIST   V1
INPUT FORMAT    FIXED(F3.0)
INPUT MEDIUM    DISK
SUBFILE LIST    DIASTOL1(24),DIASTOL2(24),DIASTOL3(24),DIASTOL4(24),DIASTOL5(24)
ONEWAY          V1 BY SUBFILES/RANGES=SCHEFFE/
STATISTICS      ALL
FINISH
```

21. Format statement for comparison of isokinetic and isometric exercise - mean blood pressure

(a) statement to get raw data combination of maximum isokinetic exercise (first exercise bout) and maximum voluntary contraction in isometric exercise (using * midas)

```
READ FILE=ISOKEX FORMAT=(T153,F6.2) VAR=1 LABEL=MBP1 CASES=1-24
READ FILE=ISOKEX FORMAT=(T182,F6.2) VAR=1 LABEL=MBP2 CASES=25-48
READ FILE=ISOKEX FORMAT=(T210,F6.2) VAR=1 LABEL=MBP3 CASES=49-72
READ FILE=ISOMEXQD FORMAT=(T50,F6.2) VAR=1 LABEL=MBP4 CASES=73-96
READ FILE=ISOMEXHM FORMAT=(T50,F6.2) VAR=1 LABEL=MBP5 CASES=97-120,
WRITE FILE=MBP10 FORMAT=F7.2 VAR=1 CASES=ALL
FINISH
STOP
```

(b) statement to compare isokinetic and isometric exercise by one way analyses of variance (using * spss)

```
RUN NAME        COMMBP
FILE NAME       COMMBP
VARIABLE LIST   V1
INPUT FORMAT    FIXED(F7.2)
INPUT MEDIUM    DISK
SUBFILE LIST    MBP1(24),MBP2(24),MBP3(24),MBP4(24),MBP5(24)
ONEWAY          V1 BY SUBFILES/RANGES=SCHEFFE/
STATISTICS      ALL
FINISH
```

22. Format statement for comparison of isokinetic and isometric exercise - modified tension time index

(a) statement to get raw data combination of maximum isokinetic exercise (first exercise bout) and maximum voluntary contraction in isometric exercise (using * midas)

```
READ FILE=ISOKEX FORMAT=(T236,F6.2) VAR=1 LABEL=MTTI1 CASES=1-24
READ FILE=ISOKEX FORMAT=(T264,F6.2) VAR=1 LABEL=MTTI2 CASES=25-48
READ FILE=ISOKEX FORMAT=(T292,F6.2) VAR=1 LABEL=MTTI3 CASES=49-72
READ FILE=ISOMEXQD FORMAT=(T78,F6.2) VAR=1 LABEL=MTTI4 CASES=73-96
READ FILE=ISOMEXHM FORMAT=(T78,F6.2) VAR=1 LABEL=MTTI5 CASES=97-120
WRITE FILE=MTTI100 FORMAT=F7.2 VAR=1 CASES=ALL
FINISH
```

(b) statement to compare isokinetic and isometric exercise by one way analyses of variance (using * spss)

```
     1      RUN NAME          COMMTTI
     2      FILE NAME         COMMTTI
     3      VARIABLE LIST     V1
   3.5      INPUT FORMAT      FIXED(F7.2)
     5      INPUT MEDIUM      DISK
     6      SUBFILE LIST      MTTI1(24),MTTI2(24),MTTI3(24),MTTI4(24),MTTI5(24)
     8      ONEWAY            V1 BY SUBFILES/RANGES=SCHEFFE/
     9      STATISTICS        ALL
    10      FINISH
END OF FILE
```

23. Format statement for comparison of isokinetic and isometric exercise - pulse pressure

(a) statement to get raw data combination of maximum isokinetic exercise (first exercise bout) and maximum voluntary contraction in isometric exercise (using * midas)

```
READ FILE=ISOKEX FORMAT=(T320,F6.2) VAR=1 LABEL=PP1 CASES=1-24
READ FILE=ISOKEX FORMAT=(T349,F6.2) VAR=1 LABEL=PP2 CASES=25-48
READ FILE=ISOKEX FORMAT=(T378,F6.2) VAR=1 LABELS=PP3 CASES=49-72
READ FILE=ISOMEXQD FORMAT=(T107,F6.2) VAR=1 LABEL=PP4 CASES=73-96
READ FILE=ISOMEXHM FORMAT=(T107,F6.2) VAR=1 LABEL=PP5 CASES=97-120
WRITE FILE=PP10 FORMAT=F7.2 VAR=1 CASES=ALL
FINISH
```

(b) statement to compare isokinetic and isometric exercise by one way analyses of variance (using * spss)

```
RUN NAME        COMPP
FILE NAME       COMPP
VARIABLE LIST   V1
INPUT FORMAT    FIXED(F7.2)
INPUT MEDIUM    DISK
SUBFILE LIST    PP1(24),PP2(24),PP3(24),PP4(24),PP5(24)
ONEWAY          V1 BY SUBFILES/RANGES=SCHEFFE/
STATISTICS      ALL
FINISH
```